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THE DENTAL PRACTITIONER
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Vol. XII, No. 2 October, 1961

PRECISION IN THE REAMING AND ROOT FILLING OF TEETH

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THE object of root-canal therapy is the complete débridement of the canal and replacement of the contents with an inert and sterile material, while avoiding trauma to the periapical tissues, which are in any case accessible to the normal defence mechanism of the body (Cahn, 1955). This can best be achieved by enlarging the root canal to a known dimension and obturating it by the cementation of a silver point of the same size.

The use of the adjustable type of reamer enables a high degree of accuracy to be achieved during the cleansing of a root canal, and the adoption of a sectional silver point technique, as described by Nicholls (1958), gives precision to the filling. This combination of techniques has been used for over two years by the authors with encouraging results and has been introduced in the teaching clinic where, it is thought, the quality of root fillings has risen considerably.

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Many stages such as isolation of the tooth, access to the canal, extirpation of the pulp, etc., which are common to all root-canal therapy techniques, have been omitted in this description and only features specific to this technique are included.

THE REAMING TECHNIQUE

The Adjustable Reamers (by Zipperer).—Each reamer is in two parts consisting of a numbered "test handle" and the reamer itself (*Fig.* 1). To facilitate their assembly the sizes of both are indicated by colours. The hub of the handle is wide and flat and is intended to impinge on the incisal edge or cusp of the tooth during use, thus acting as a stop. The effective length of the reamer can be adjusted from 20 to 30 mm. by sliding the reamer through the handle. When set at the required length the reamer is locked in position by tightening the nut on the handle, preferably with the spanner and holder provided. It has been found in practice that the markings on the handle intended to indicate the effective length of the reamer are not always accurate,

and this should be checked with a pocket ruler. Such inaccuracy is due to wear and tear or slight corrosion of the thread on the handle, causing the nut to tighten past or short of the intended position and giving an error of $\pm$ 1 mm.

Assessment of Tooth Length.—The exact assessment of the tooth length, apex to incisal edge or cusp, is the first step preparatory to accurate reaming. Penetration of the apex is undesirable as infection may be carried into the periapical tissues and unnecessary trauma caused. On the other hand, if reaming is commenced short of the apex, a ledge may be formed which could prevent access to the important apical part of the root canal.

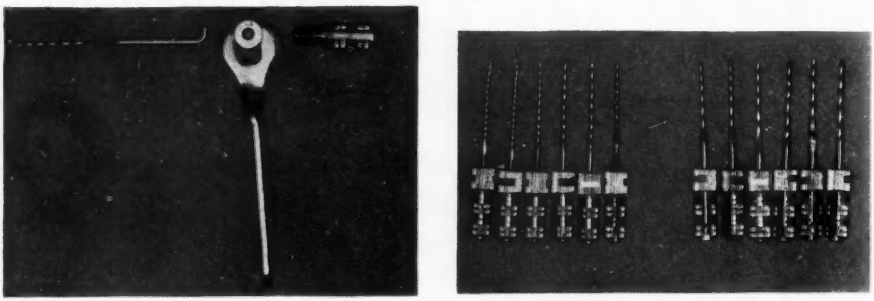


Fig. 1.—Zipperer reamers and test handles.

A fine reamer set to a known length which will approach yet avoid penetrating the apex is gently introduced to the canal until the hub of the reamer handle is against the incisal or occlusal margin, and a radiograph taken. Experience has shown that for upper incisors and all canines the reamer may be set at 20 mm.; for the lower incisors, 18 mm. However, clinical judgement and possibly a pre-treatment radiograph may be required.

Though the minimum length to which these reamers may be adjusted is 20 mm. for reaming, they may be shortened to less than this for estimating root lengths.

The radiograph will show the tip of the reamer at a known distance from the incisal edge (*Fig.* 2 A). The distance, x mm. (*Fig.* 2 B, C), between the root apex and the tip of the reamer is measured directly from the radiograph, and is added to the known length of the reamer to give the total length of the tooth. For an upper first incisor, for example, the full length will be $20+x$ mm.

The reason why this procedure is necessary in the first instance is that a radiograph is invariably distorted to some degree. The distortion can be estimated by measuring the length of the diagnostic reamer as shown in the radiograph, and comparing this measurement with the known length—however, this distortion is not necessarily constant throughout the length of the tooth, due to such factors as the divergence of the X-ray beam and the bending of the film. The use of such a correction ratio is therefore not necessarily accurate when the whole length of the tooth is measured. If, however, only the short distance "x" is measured, any slight distortion of this will cause an error in the estimation of the total length of the canal of only a fraction of a millimetre, being well within tolerable limits.

Reaming.—All reamers are set to the known tooth length and in turn introduced fully into the canal. When the hub impinges on the incisal edge, it is known that the tip of the reamer is exactly at the apex. Reaming should always commence with the smallest reamer, as this will successfully negotiate any irregularities and avoid creating ledges, though quite often the smaller reamers do little or no reaming (*Fig.* 3). When some dentine is first removed from the canal walls, it is normally an indication that the width of the reamer is the same as the narrowest diameter of the

pulp canal. This dentine is easily recognized as a whitish powder in the flutes of the reamer. Reaming is then continued to at least two sizes greater to remove dentine around the entire circumference of the pulp canal. Thus an irregular or elliptical canal is reamed circular (*Fig.* 4).

This removal of dentine from the canal walls is considered the most important factor in creating a clean circular canal of known size, which can be completely and accurately obturated with a silver point of matching size. If remnants of pulp tissue remain attached to the walls, they will provide a nidus for bacterial growth and reduce the effectiveness of antibiotics or antiseptics. The canal will also remain an unknown and irregular shape.

Sterilization.—Numerous antiseptics and antibiotics are available with which to sterilize an infected root canal, and each practitioner has his favourite. It is believed that if reaming has been satisfactorily performed, then the choice of drug is of secondary importance—to be regarded more as a simple dressing for the canal between visits than as a sterilizing agent. This is emphasized by Cahn (1955), who recommends adequate reaming of root canals followed by immediate filling, without resorting to the use of drugs. If the canal is adequately cleaned mechanically and then filled completely, any remaining bacteria can only be situated in the periapical tissues where they will succumb to the natural defence mechanism. However, this paper is not principally concerned with the controversial subject of sterilization. When the operator considers the canal to be ready for filling, it is filled.

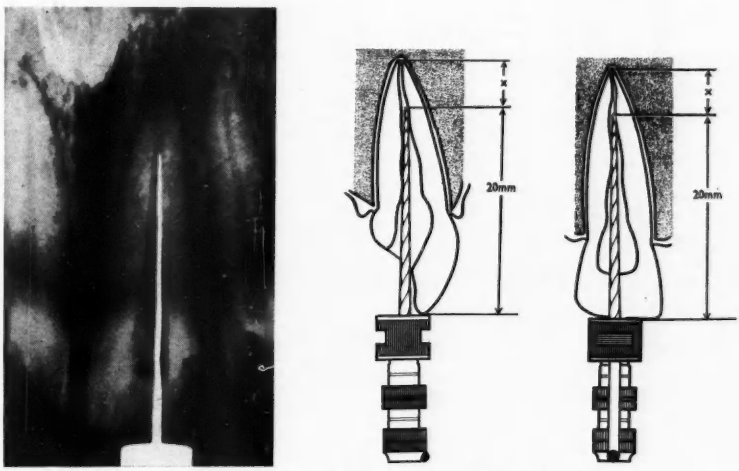


Fig. 2.—The reamer set at 20 mm. inserted into the canal.

THE ROOT-FILLING TECHNIQUE

The Material.—For accuracy, the root filling of choice is a silver point cemented in place with zinc phosphate cement. Being rigid, a silver point can be introduced exactly to the apex, something that is often difficult to do with a gutta-percha point with its tendency to buckle.

The construction of a post crown necessitates the partial removal of the root filling; if the whole of the root canal is filled with silver this can be very difficult. However, the technique described by Nicholls (1958) overcomes this difficulty by filling only the apical third of the canal with silver. Unfortunately the silver points produced by Zipperer are only 15 mm. long and do not

accurately correspond in size with the reamers. The authors have found the Produit Dentaire silver points satisfactory and consistent in reamer with a vulcarbo disk. The silver point is marked at a distance from its tip equal to the tooth length, and tried in the canal: the

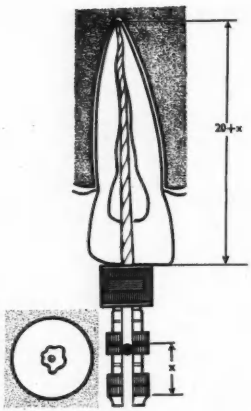
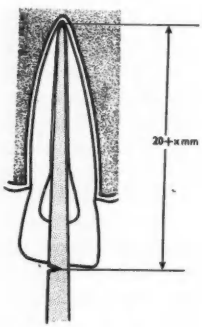
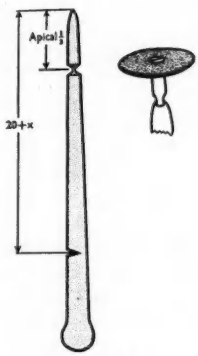


Fig. 3.—The reamer set at $20+x$ mm. inserted into the canal. (*Inset*—Transverse view of a root showing a fine reamer lying in the irregular canal.)

Fig. 4.—The final reamer in position. Longitudinal view. (*Inset*—Transverse view of a tooth showing the smooth circular canal conforming to the size and shape of the final reamer.)





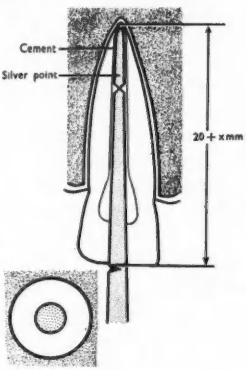


Fig. 5. *Fig.* 6. *Fig.* 7.

Fig. 5.—A silver point, equivalent in size to the final reamer, marked at $20+x$ mm., and tried in the canal.
Fig. 6.—The preparation of the silver point.
Fig. 7.—The prepared silver point cemented in the canal. (*Inset*—Transverse view of the apical third.)

size, but have found it necessary to produce *Table I*, which relates the Zipperer reamer sizes to the silver point sizes.

The Technique.—A silver point is chosen with a diameter comparable to that of the fully reamed canal. The bevel on the tip of the silver point is matched to that of the coincidence of the mark with the incisal edge (*Fig.* 5) indicates that the point is satisfactorily inserted to the apex. The silver point is then withdrawn and grooved with a vulcarbo disk at a point approximately 3–4 mm. from the tip. This leaves a thread-like connexion between the tip portion and the rest of the

point which will subsequently be readily severed (*Fig.* 6). A thin mix of zinc phosphate cement is picked up on the tip portion and the whole point replaced in the canal until

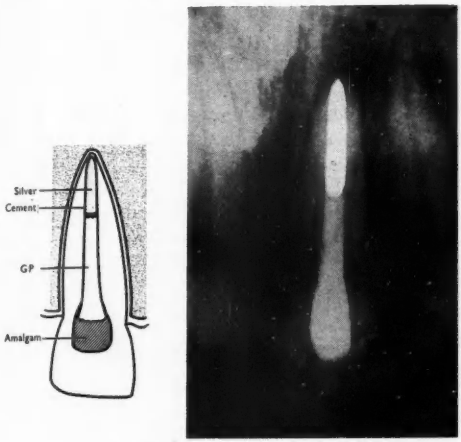


Fig. 8.—The final root filling.

the mark is again opposite the incisal edge (*Fig.* 7).

When the cement has set, the extruding portion of the silver point is given a complete twist and is then withdrawn leaving the silver point cemented only in the apical one-third of the canal (*Fig.* 8). The coronal two-thirds of the canal may be filled with a gutta-percha point, loose or cemented with zinc oxide-eugenol paste, and sealed with cement or amalgam.

In this way the two most important factors that contribute to a good prognosis in root-canal therapy—precise reaming and precise filling—are carried out to a satisfactory degree of accuracy.

Table I.—Table of Zipperer Adjustable Reamers and Comparable Silver Points (Produits Dentaire)

Reamer No.	*Silver Point No.*
2	3
4	4
6	5
8	6
9	7
10	8
11	9
12	10

SUMMARY

A technique for precision reaming and root filling is described. The reaming is carried out with adjustable reamers. A section of silver point is inserted as a root filling.

Acknowledgements.—Grateful acknowledgement is made to the Department of Medical Illustration of the United Manchester Hospitals for the photographs and line drawings.

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Nicholls, E. (1958), *Dent. Practit.*, **8**, 241.

GASEOUS FORMALDEHYDE IN ENDODONTICS

The method described consists of inducing the depolymerization of pure trioxymethylene, 1-triformol (CH_2O_3), by beechwood creosote. Formic aldehyde (C.HOH) is released as a gas and diffuses more readily than in solution. This denatures the protein of the pulp.

Industrial trioxymethylenes (CH_2O) are not suitable for this purpose as they are oxidized into formic acid (H.COOH), a severe tissue irritant. Although this may be impeded by the addition of alkali or reducing agents—the alteration of *p*H to the alkaline side tends to be detrimental to tissue repair.

The technique employed is as follows: The pulp chamber is opened and the canals cleared, washed, and dried. A pledget of cotton-wool soaked in beechwood creosote and rolled in powdered trioxymethylene is placed in the cavity and sealed in. The dressing should be left at least twenty-four hours, and repeated. The canals may then be filled.

The author claims numerous advantages: simple technique, ease of treatment, X-ray healing of periapical lesions, virtually no sensitivity reactions, and a high percentage of successes. He prefers this method to the uses of antibiotics.—Bader, J., and Neu, E. (1960), *Rev. franç. odontostomat.*, **7**, No. 5.

M. Pleet

EXPANDED METAL SPECIAL TRAYS FOR CROWN AND INLAY WORK

By **ERIC K. JOSEPH**, F.D.S. R.C.S.
University of Bristol Dental School

HYDROCOLLOID and elastomer impression materials have, since their introduction, made a great contribution to crown and inlay techniques. In order to ensure their accuracy, however, they must be firmly attached to a rigid tray. If this is not achieved, dimensional changes may take place during and after removal of the impression from the mouth. Special perforated trays satisfy this requirement, but their construction has hitherto been time consuming and expensive. Expanded aluminium, however, is a material which can be easily and quickly shaped for the individual case and yet be absolutely rigid when supporting the impression material. Furthermore, it is cheap enough to be expendable.

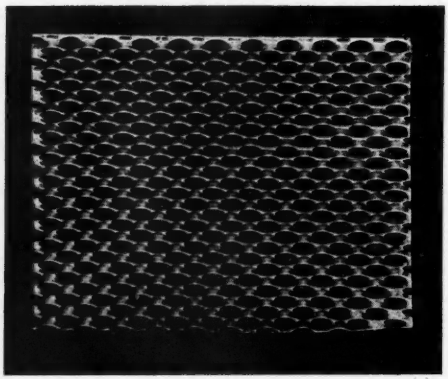

Fig. 1.—Expanded metal sheet.

It is manufactured by slitting and expanding a sheet of rolled metal, thereby creating a strong continuous mesh. This versatile material is made in steel, aluminium, brass, and copper. Its uses in many branches of industry range from loudspeaker and radiator grilles to heavy duty fencing. It is measured by taking the shortway distance across the diamond mesh (S.W.M.) (*Figs.* 1 and 2), and is available in sizes ranging from S.W.M. 3 mm. to S.W.M. 1·5 in., and thicknesses ranging from 24 G. to $\frac{1}{8}$ in. The size which has been found most suitable for impression trays is $\frac{1}{16}$ in. S.W.M. aluminium in 20 G. (reference number 602A).*

CONSTRUCTION OF THE TRAY

A suitable piece of expanded metal should be cut from the main sheet with a large pair of scissors; it can then be bent to shape by finger-pressure and any final adjustments can be made with pliers, after trying it in the mouth. The tray should not only cover the desired region, but should fit it quite closely, thereby ensuring an even layer of impression material as well as economy in its use (*Fig.* 3). To achieve absolute rigidity with a large tray the metal should be doubled before bending. The operator will soon learn to make such trays quite quickly for any segment of the arch.

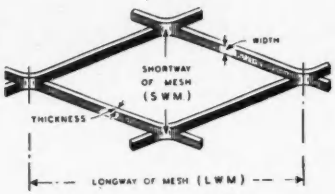

Fig. 2.—Measurement of the mesh.

INDICATIONS FOR USE

1. Irreversible Hydrocolloid Localizing Impressions for Crown and Inlay Work.—The hydrocolloids provide a simple yet accurate method of recording the adjacent teeth and tissues and also the opposing teeth. An impression of the preparation is first taken with

* The Expanded Metal Company Ltd., 16 Caxton Street, London, S.W.1.

composition in a copper ring and a die is made. Expanded metal trays are then made for upper and lower arch segments. A wax or acrylic transfer coping is then fitted to the preparation in the mouth and the trays are loaded. They are small enough to allow both upper and lower to be placed in the mouth at the same time (*Fig.* 4). Once the material has set the trays are removed and the die is localized into the impression before casting

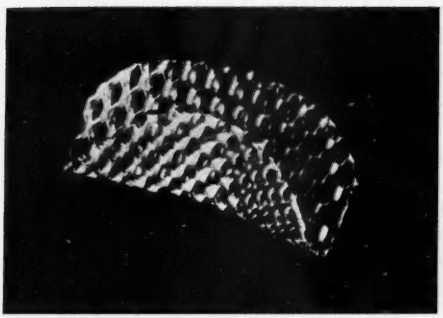

Fig. 3.—Metal tray bent to shape.

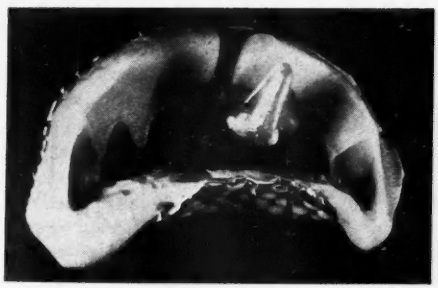

Fig. 5.—Die localized into wax coping.

the working model. In order to ensure that it remains in position during casting the die may be attached by means of sticky wax to two pins which transfix the impression (*Fig.* 5).

If the hydrocolloid localizing impressions are taken immediately after the copper ring impression they should be prevented from dehydrating by placing them in a humidor or bath of liquid paraffin until such time as the die has been constructed.

2. Over-all Elastomer Impressions for Crown and Inlay Work.—When *all* the information is to be recorded upon one impression, expanded metal trays are made for upper and lower arch segments. The gingivæ must be packed away from the margins of the preparation so that the latter are clearly defined, and the syringe

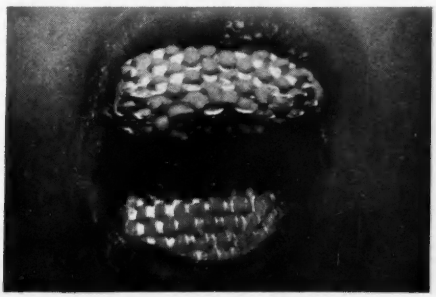

Fig. 4.—Both trays in position.

Fig. 6.—Impression and model for cervical porcelain inlays.

material must be introduced carefully so that no air is trapped in the preparation. The remaining material in the syringe may then be used to overlay the whole region. The trays, which have been loaded with a somewhat thicker mix of material, are then both placed in the mouth and held there until the material has set.

It has been shown that improved results will be obtained with elastomers by doubling the

manufacturers' recommended setting time in the mouth and casting the models within a few hours after their removal.

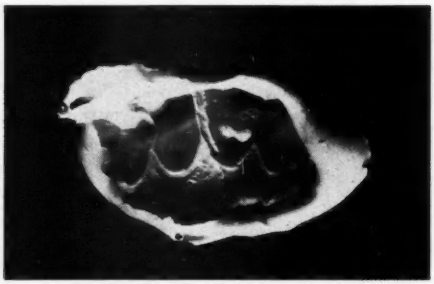

Fig. 7.—Elastomer impression of Class IV cavity.

3. Multiple Cervical Porcelain Inlays using Elastomer Impression Material.—As many as four cervical inlay cavities may be prepared at one time. The impression is taken in elastomer, supported by an expanded metal tray. The model is then cast in refractory investment and the inlays are baked directly in this (*Fig.* 6). A copper-plated or stone model may then be cast from the original impression so that the inlays may be finished upon it and presented at the chairside.

4. Class IV Inlays using Elastomer Impression Material.—The same technique allows Class IV inlays to be made by the indirect method. The elastomer adheres so firmly to the tray that when the impression is removed vertically *against* the path of withdrawal of the inlay it does not distort (*Fig.* 7).

SUMMARY

A material for making special perforated trays has been described. The construction of trays and their application to impression techniques has been indicated.

Acknowledgement.—The author wishes to thank Mr. F. D. Godman, Medical Photographic Department, University of Bristol, for the illustrations.

TRANSPLANTATION OF TEETH IN MAN

Autografting (the transplanting of tissues within the same individual) of teeth in various stages of development has been successfully performed with the help of an understanding of the underlying physiology and pathology. An autograft from the leg to the face of an individual will "take" in 6–8 days and become ultimately a successful graft. A homograft (one between different individuals of the same species) between leg and face will also "take" in 6–8 days, but on the eighteenth day it will become œdematous, inflamed, ulcerated, and lost. Should now a similar graft between the same two individuals be tried it will not "take" at all, but it will be shed at once. This suggests that an antibody reaction has taken place because the host appears to have developed an immunity to the second graft owing to exposure to the antigens of the first graft. Evidence is given to show that the changes taking place after a homograft has been placed occur mainly in the lymphopoietic system. In surgery the effect of this system is illustrated thus: immediately preceding homografting, the entire lymphopoietic system is subjected to mass radiation to prevent subsequent immunological reaction by the host to the grafted tissue, and it has been suggested that the antigen which is the stimulus to transplant immunity is the function of the living cell. The grafted tissue is continually liberating antigen. This is recognized as foreign when it reaches the regional lymph-node and there is then set up an immunological response. In this connexion it is interesting to find that in those cases where the nodes have been experimentally removed as soon as an enlargement occurred, considerable delay in graft rejection followed. In dentistry, cases occur where, following root-filling, transplantation is desirable, e.g., misplaced maxillary canines. The case illustrated here deals with the satisfactory transplantation and temporary fixation of a lower right canine tooth.—SNIJMAN, P. C. (1961), *J. dent. Ass. S. Afr.*, **16**, 44.

G. E. B. MOORE

THE SUPPORTING STRUCTURES

I. THE SUPPORTING STRUCTURES OF THE TEETH IN RELATION TO PROSTHETICS

By Professor **F. E. HOPPER**, M.D.S., F.D.S., B.D.S.
School of Dental Surgery, University of Leeds

IN the words of the cliché-monger, a specialist is a person who knows more and more about less and less until the supreme expert is reached who knows everything about nothing. When two such experts are prepared to combine to consider common ground, it raises hopes that the days of the superspecialist might perhaps after all be numbered, and at the same time fears that any remarks which are made by me will be brought to such highly detailed scrutiny and examination that however solid one's beliefs may have appeared beforehand, they soon begin to take on a resemblance to a rather rusty colander.

As one who has spent many years in the practice of periodontology I must declare my vested interests at the outset. The most important one is a belief that in the mouth a natural tooth is to be preferred to a false tooth. Secondary to this, I would say that periodontal disease is very common in man and is a major cause of tooth loss. It is progressive with advancing age, but also relatively painless. If the disease process is left untreated it will inevitably lead to bone loss and in due course to the loss of the tooth itself. I am not proposing to consider the relative importance of local and systemic factors in this connexion, but will only say that they always exist together, and that the response of the tissues to local irritation is conditioned and modified by the systemic background which is not merely the "bone factor" described by Glickman (1953), but the complete compass of factors, including genetic, environmental, sex, age, the presence of intercurrent diseases, allergies, etc. This problem is very ably surveyed by Price in his highly stimulating article in the DENTAL PRACTITIONER of July, 1959.

The supporting structures of the teeth are the means whereby the tooth is rendered functional, and they include the periodontal membrane, the cementum and alveolar bone which lie on either side of it, and the gingival tissues which overlie it, and by means of the epithelial cuff provide a degree of resistance to mechanical and bacterial assault from outside. The periodontal membrane itself contains many elements of which the most important from the point of view of function is the fibrous element arranged in bundles and passing from the tooth to the bone.

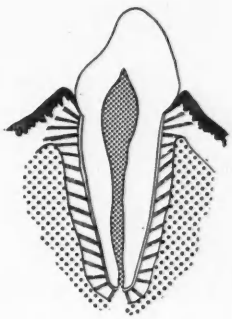

Fig. 1.—Fibres of the periodontal membrane in diagrammatic form (*after Noyes*).

The diagrams provided in the text-books of dental histology give a clear picture of how these bundles are arranged. The free gingival, the trans-septal, the crestal, the horizontal, the oblique, and the apical (*Fig.* 1) provide a neat mechanical image of the tooth being held in a sling and capable of being moved up and down and even in a rotary fashion. The wavy nature of the fibres gives an apparent explanation of the ability of the tooth to move; the fibres straighten out as the forces of tension are applied to them. When the greater part of the periodontal membrane is examined closely, however, the simple

Papers read before the B.S.S. Prosthetic Dentistry at the meeting held on March 28–9, 1960.

diagrammatic picture is not so readily seen. Fibres in bundles may be seen passing into the cementum and into alveolar bone, but in the central part of the periodontal membrane the bundles expand, divide, branch, and intertwine until all semblance of order seems lost in the mesh of an interlinked fibrous mattress.

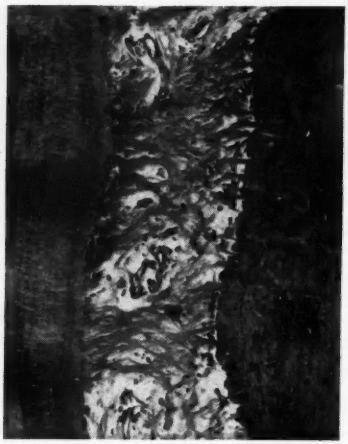

Fig. 2.—Break-up of fibre bundles of the periodontal membrane.

Neither does the wave form of the fibres appear to withstand critical examination. When Gabel (1956) applied mathematical methods, he was not able to reconcile the movement of the tooth produced when it is pushed sideways with the simple straightening out of the kinks in the fibre bundles. He amplified the theory of the periodontal membrane as an incompressible hydraulic membrane put forward by Synge (1937), and stated that when pressure is applied to a tooth it moves because the hollow vessels containing fluid which lie in the periodontal membrane are caused to collapse, the fluid passing into the vessels of the alveolar bone. When this has occurred the resistance of the periodontal membrane to further movement is very high indeed and corresponds to the incompressible hydraulic layer found when a fluid lies between two flat surfaces. Increase of lateral pressure produces no further displacement of the tooth until the alveolar bone itself begins to bend. This plateau in the graph has been clearly demonstrated by Muhlemann (1954a, b) and is always present in living material. If the jaw is pickled in formalin and the experiment repeated, no plateau occurs—a straight line deflection in the graph occurring as lateral pressure is applied to the crown. Gabel points

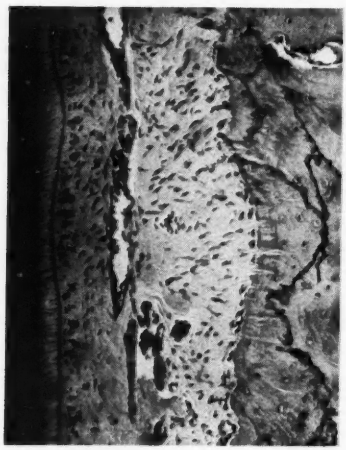

Fig. 3.—Vessels of periodontal membrane.

out that when two parallel plates supported by an incompressible liquid are pressed together, powerful forces are developed laterally in the fluid. Applying this to the tooth, he suggests that a lateral force applied to the crown is translated into a tangential force within the periodontal membrane in the same way that the load of a suspension bridge roadway is transmitted along the main cables supporting it. This view would agree with the histological picture in which the bundles break up rapidly after leaving the tooth or bone and then take up a direction lying at a tangent to the curved surface of the root (*Figs.* 2, 3). In his view, the fibres are partially responsible for the support of the tooth by the tension developed in them by these tangential forces. It would also affect the belief that a tooth more readily withstands stresses in an axial direction, as has commonly been supposed, and suggests that lateral stresses are, in fact, capable of being resisted strongly.

When heavy and unnatural forces are applied to a tooth, what changes occur? This problem has been examined on many occasions, especially in experimental studies of tooth movement for orthodontic purposes. When heavier forces are applied deliberately, the picture becomes more complicated. Orban (1928) fixed crowns to the teeth of monkeys and found that the force of mastication led to death by strangulation of areas of the periodontal membrane which were crushed between the tooth and the bone, but that resorption of this bone followed and allowed the proliferation of new periodontal fibres. Waerhaug (1955) placed metal crowns on the cheek teeth of dogs in such a way as to produce lateral and occlusal stresses. Resorption of the alveolar bone occurred, which allowed the tooth to be depressed in its socket while the health of the periodontal membrane appeared unimpaired. The crowns were removed and the tooth moved coronally again, the crowns were replaced, and again the teeth were driven down. No reports are available on the subjective emotion of the animals during this time, but at the end of the experiment there was no permanent destruction of the periodontal membrane, and where the gingival crevice had been in a healthy condition, as was usually the case, there was absolutely no evidence of a periodontal pocket. Because of the long-held view that occlusal trauma led to pocket formation, a more refined version of this experiment was carried out by Wentz, Jarabak, and Orban (1958), who applied crowns of such a form to the premolar teeth of monkeys that the teeth were driven buccally. Orthodontic appliances with springs were inserted at the same time to ensure that, as the occlusal pressure was released, on opening the mouth the tooth was pressed outwards again. This constant jiggling of the tooth led to a periodontal membrane three times thicker than normal, and although the root became very loose (not surprisingly), no gingivitis or periodontitis occurred.

These findings may be summarized as showing that excessive occlusal or lateral force, even if intermittent and "jiggling" in character, is not likely to lead to gingivitis or pocket formation if there is not a pre-existing chronic periodontitis already present.

Other animal experiments which I carried out personally showed that the periodontal tissues possess remarkable powers of resistance

Fig. 4.—Reattachment following experimental surgery.

to chronic trauma and infection (1958). The basis of these experiments was the production of an artificial pocket on the buccal and palatal aspects of canine and premolar teeth in the cat. In some instances metal bands were cemented to the crown of the teeth in order to hold metal tags in the pocket created by burs and chisels and prevent reattachment for three weeks. This allowed chronic infection to occur and calculus and bacterial plaque to form in the pocket. Earlier work had suggested that, in this situation, the epithelium lining the gingival crevice would grow down to the most apical point in the artificial pocket. In fact, a considerable degree of true connective-tissue reattachment was obtained in a number of cases, even in the continuing presence of chronic inflammation and calculus formation (*Figs.* 4, 5).

What are the practical applications of this? In spite of the tendency to persistence and extension that periodontal disease shows, I believe that the progress of periodontitis

can be checked by measures designed to reduce local irritation, especially the removal of calculus lying within the periodontal pocket. In favourable circumstances, reattachment is possible and conservative measures such as curettage and the various flap operations are methods which might be applied. The use of bone chips and anorganic bone in this situation is still in the experimental stage and the results may not justify the extra time and trouble involved. The old standby of gingivectomy still has a very great deal to recommend it, especially as the result is more certain and usually achieved more quickly, and if an increase in the clinical crown of the tooth is accepted.

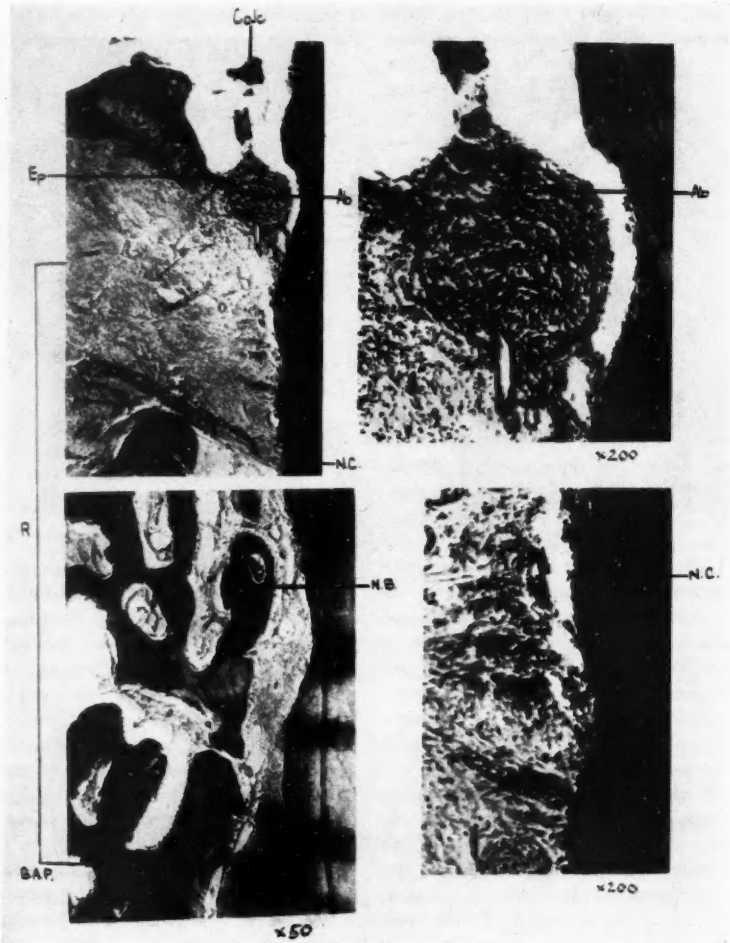

Fig. 5.—Reattachment following experimental surgery with bone production in spite of continued chronic inflammation.

When teeth have been lost as a result of chronic periodontal disease, what then? Farrell

(1956, 1957) has shown that while the chewing of meat might increase the proportion utilized in the gut, with many foods this does not apply, and in any case a very considerable number of teeth must be lost before any measurable effect on the efficiency of mastication is observed. Leaving out cosmetic considerations for the present (while not denying their importance), I feel that in a partially dentulous mouth the attention should be directed principally to the teeth which remain rather than to the gaps which have been created. The construction of a partial denture should not cause irritation to the soft tissues nor, by providing zones of stagnation, should it lead to the formation of calculus. The use of occlusal rests and clasps should not merely be means of limiting movement of denture saddles, but, by extension, be allowed to form splints for the remaining teeth. The tremendous advantage given to us by the use of cobalt-chrome alloys allows the partial denture to be regarded as a periodontal splint which gives support to the remaining teeth and spreads the occlusal load rather than as a cheap means of filling gaps with metal. The harmful effects of habits such as pencil-biting, pipe-chewing, and nocturnal bruxism can all be counteracted in the same way.

In the construction of more everyday partial dentures the avoidance of damage to the gingival margin is important. The roll of soft tissue trapped between tooth and denture is a feature to be avoided at all costs. Carrying metal over the gingival margin on to the lingual or palatal aspect of the crowns of the teeth produces surprisingly little damage to the soft tissues. This technique is one which is very familiar in partial metal dentures and I understand that Mack (1959) has reported favourably on the use of a modification of this technique in acrylic-based dentures.

The patient who blandly states that partial dentures always lead to loss of other teeth may be speaking the truth, but it is surely true only if basic principles have been flouted. If the need to replace natural teeth with false ones by means of a removable appliance has been accepted, the care needed to preserve the natural teeth is probably increased, but is not beyond the reach of simple measures carried out by the patient and the dental practitioner.

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II. THE REPLACEMENT OF POSTERIOR TEETH BY A REMOVABLE PROSTHESIS

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THE reasons given for the replacement of missing cheek teeth are many. They include restoration of appearance, mastication, and speech, the maintenance of contact points, the support of the soft tissues of tongue and cheeks, the relief of overstress of the remaining teeth during function, the prevention of drifting and over-eruption, and the maintenance of normal jaw and joint function. It has been said (Hirschfeld, 1937) that the loss of a single tooth should be made good immediately, as the integrity of both arches lies in the keystone of one unit. Whilst such treatment may be the ideal for which we all aim, the present state of dental conscience of our patients, and of dental economics in this country, does not allow us to carry it out. In addition, other reporters give their opinion that replacement of posterior teeth is not essential until several units of the dentition have been lost.

Whenever a natural tooth is replaced by a partial denture, the damage which will be caused and the good achieved are weighed against each other. There must always be a credit balance in favour of the denture. Certain types of denture, notably the thoughtlessly constructed "simple" acrylic plate, have been shown to be a liability rather than an asset to the life of the dentition (Anderson and Lammie, 1952; Koivumaa, 1956). Other dentures, particularly those of skeleton design, have been shown to cause little damage (Anderson and Bates, 1959). Many theories of denture design are held which try to reduce the theoretical ill-effects of denture wearing. However, it is only by long-term clinical assessment of the effects of wearing partial dentures that conclusions can be drawn (Osborne, Brills, and Lammie, 1957).

Kennedy (1942) divides partial dentures into four classes. The first part of this paper deals with Kennedy Class III and its modifications. In this type of dentition, teeth are missing from within the arch, leaving bounded saddles. Secondly, the loss of teeth from the end of the arch will be discussed, that is, Kennedy Classes I and II.

Fig. 1.—Palatal bar denture.

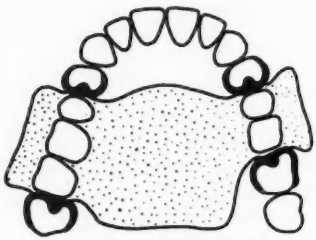

Fig. 2.—Palatal plate denture.

Fig. 3.—Lingual bar denture.

Fig. 4.—Lingual plate denture.

LOSS OF TEETH WITHIN THE ARCH

In the upper jaw, posterior teeth can be replaced either by a palatal bar (*Fig.* 1) or palatal plate (*Fig.* 2) type of denture. Provided the denture derives support in occlusal and lateral directions from all four abutment teeth, either of these dentures will not reduce the life-span of the dentition. The function of this type of denture is to maintain arch continuity, prevent over-eruption and drifting and its effect upon occlusion, and, where several teeth are missing, to take a minor part in mastication. It appears also to assist in the preservation of the remaining alveolar ridge. A criticism can be made that these dentures cause a higher caries incidence by making less effective the normal cleansing activity of the mouth.

Similar credit can be given to a lingual (or buccal) bar-type denture (*Fig.* 3) in the lower jaw. Here, adequate support against occlusal

and lateral forces is even more important. Where patient tolerance of a bar is poor, then a lingual plate (*Fig.* 4) in metal is advised. If small saddle areas are present, owing to the loss of only one unit bilaterally, then preference can be given to another type of denture (*Fig.* 5) which has all the advantages and none of the disadvantages of a similar denture with resin saddles. So long as the first premolars and last molars at least remain to give good occlusal support, any one of these types of denture does little harm to the remaining dentition provided they are accurately constructed and well maintained by both patient and dentist, and are not worn at night. Maintenance by the patient is most important since, unless good oral cleanliness is continued, a prophylactic denture can become a "break-down" appliance.

Where only small saddles exist, these dentures do little harm, but do they always do good? Are there indications when the self-cleansing spaces may be left? Many patients are seen in whose mouths the loss of a few posterior teeth does not cause rapid deterioration of the occlusion.

The discussions in this paper will be limited to dentitions composed of fully erupted teeth, with the exception of the last molars.

In a normal adult occlusion, with moderate overbite, the curvature of the occlusal surfaces of the posterior teeth is of moderately long radius. When correct interdigitation of teeth exists, the loss of single units in the upper jaw does not appear to cause tilting, though some mesial drifting may occur. Here our hand articulator, as suggested by Krogh-Poulsen, would show smooth movement of the occlusal surfaces of the teeth over each other. Loss of molar teeth in the lower jaw, however, does allow over-eruption, drifting, and tilting. This is due partly to the fact that the upper molars, particularly the second, are smaller mesiodistally than the lowers (Scott and Symons, 1958), but mainly to the difference in type of drifting between upper and lower molar teeth. In general, upper molar teeth move bodily, whilst lower molars tilt forwards. The loss of a lower premolar in a fully erupted dentition appears to cause less effect upon the dentition, as the remaining premolar is held in position by normal articulation.

When the third molars are erupting, the effect of loss of the second molar may not be so serious. Smith (1958) showed that, in general, the erupting upper third molar came into good position in contact with the first molar, whilst in the lower jaw the tooth came into proximal contact, but was often tilted.

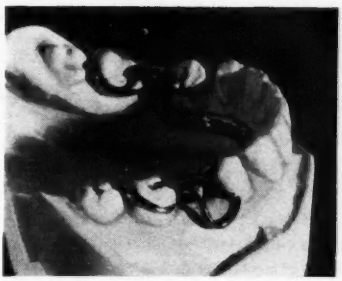

Fig. 5.—Denture without resin saddles.

It would appear, therefore, that in a normal dentition in good occlusion the loss of single units in the upper jaw, for example $\underline{75|57}$, could be left untreated by a removable prosthesis. Similarly, the loss of $\overline{5|5}$ could be tolerated. Certainly, if oral hygiene is poor, doubts may be expressed as to whether the denture is doing as much good as harm. On the other hand, when function is heavy, as in bruxism, replacement will be necessary. Where periodontal disease has caused bone loss, then the provision of a denture is essential in order to replace contact points and prevent pathological tooth migration. Here we no longer think of a tooth-borne denture, but of mutual support between denture and dentition.

In Angle's Class II, division 1 malocclusion, and in cases of prognathism, the loss of a few units from the upper jaw might be tolerated. But upon the loss of an opposing tooth also, or where incorrect interdigitation will lead to drifting, a denture is preferred. Here the main application of a prosthesis is to prevent loss of vertical height and its effect upon the incisor teeth.

In Angle's Class II, division 2 malocclusion, the curvature of the posterior teeth is often of a smaller radius (*Fig.* 6). This type of dentition is looked upon in orthodontics as rather unstable in form, though Grewcock (1955) noted the general resistance of this type

Fig. 6.—Angle's Class II, division 2 malocclusion.

of dentition to periodontal disease. Loss of cheek teeth in this dentition, particularly in the lower jaw, appears to produce rapid drifting and tilting of the teeth. This may be owing to the fact that interdigitation of cusps is frequently incorrect in these patients. Many Angle's Class II, division 2 dentitions are "halfway" in a cusp-to-cusp relation. The loss of lower premolars is also serious, as this allows further backward movement of the lower incisor teeth. The effect of loss of teeth in this dentition may also be considered in another light. Such patients employ masticatory movements mainly in a sagittal plane. When masticatory function is reduced, there will be a tendency to explore more lateral movements with consequent lateral forces upon teeth hitherto loaded only in an apical direction. In this type of dentition the loss of a tooth within the dentition should be followed by replacement if we are to maintain contact points and retain the small amount of occlusal balance which is present. When insufficient room is available for eruption of the last lower molar, however, it may be preferable to allow drifting and tilting of the second molar and so enable the third molar to erupt.

To summarize, therefore, it is suggested that the loss of cheek teeth within the arch often causes deterioration of the occlusion. Replacement by a partial denture shows a credit effect upon the dentition. In some dentitions single units need not be replaced, whilst on the loss of all the cheek teeth except the last molars (*Fig.* 7), the balance between harm done by the denture and good achieved in relation to the remaining dentition is probably a fine one.

Fig. 7.—Lingual plate denture replacing $\overline{7654|4567}$.

LOSS OF TEETH FROM THE ENDS OF THE ARCH

The loss of teeth distally, leaving free-end saddles, brings into emphasis not primarily the maintenance of the natural dentition, but the necessity of applying masticatory force over as large an area of teeth, both natural and artificial, as possible. This is necessary to provide function for opponents, and to prevent muscular imbalance of the temporomandibular joint.

The loss of teeth distally up to the first molar can be tolerated provided the opponent tooth is also to be lost. However, if there is a good tooth–tissue relationship, there may be a large edentulous area left in the direct line of pull of the masseter and medial pterygoid muscles. Then a prosthesis is required.

As further teeth are lost from the ends of the arch, masticatory efficiency falls, soft tissues occupy the edentulous spaces, and jaw function becomes abnormal. "Central eating" will traumatize the remaining and opposing teeth or the opposing ridge beneath a denture, and temporomandibular joint symptoms may arise. For these reasons a denture must be provided.

When supplying a bilateral free-end saddle denture, I suggest that we are not primarily achieving much credit in relation to the continuing health of the remaining natural dentition from either caries or periodontal viewpoints. The credit is, however, better in the upper than the lower jaw as the area

of soft-tissue coverage available is much better and a more self-cleansing design can be used.

As the number of teeth to be replaced increases, the denture becomes more a replacement of teeth lost than a benefit to those remaining. Many theories have been evolved dealing with the effect of these dentures upon the abutment teeth, particularly in the lower jaw, and a great deal of activity has been directed towards ingenious denture designs. In a recent review, Anderson and Bates (1959) did not find periodontal damage to the clasped abutment teeth or gross resorption under saddles. The Class I denture causes damage because it is a denture preventing normal cleansing and traumatizing gingival tissues, particularly if incorrectly designed. It does not appear to cause the damage specifically attributable to the fact that the saddles are not tooth-supported posteriorly. The use of stress-breakers is perhaps related more to patient tolerance than to prevention of periodontal and alveolar bone damage, though Storer (1958) reported no correlation of tolerance with denture design.

It is suggested, therefore, that the free-end saddle denture, particularly in the lower jaw, does not add to the life of the remaining dentition. The denture should be designed to cause as little soft-tissue damage as possible, and yet be tolerated by the patient. In the upper jaw, where good ridge support is present, the prognosis is better. In the lower jaw, the lingual bar and continuous clasp is probably the ideal design, but patient tolerance, and strength, limit its application. The metal lingual plate requires more care in hygiene, whilst the acrylic lingual plate carried well up the cingulum of the teeth is indicated only where the dentition is deteriorating and the addition of further teeth in the near future is a possibility.

The number of unilateral free-end saddle dentures is fortunately small. The more common occurrence is the free-end saddle on one side with a bounded saddle on the other. When the saddles are small, we are increasing the chances of survival of the dentition by providing a denture. When only one molar and six incisors remain, a denture is replacing teeth lost and doing little to preserve the remaining natural teeth.

SUMMARY

When small saddles bounded by cheek teeth are present, a removable prosthesis is sometimes not required in the upper jaw if the periodontal condition is good. In the lower jaw a denture is frequently advised as a space maintainer to prevent drifting and so maintain the occlusion. When bone-loss has taken place, the provision of a denture in either jaw has a therapeutic effect upon the supporting structures. Such a denture, which does not traumatize gingival tissues nor greatly reduce natural oral cleansing, is helpful in maintaining the dentition. As the saddles increase in size, and are no longer bounded anteriorly by cheek teeth, the harm done by the denture and its therapeutic effect come to a fine balance in favour of the denture—a balance which can be tipped by the degree of oral cleanliness. When dentures replace several teeth lost from the ends of the arches their application is more a replacement of some molar function than a therapeutic effect upon the remaining dentition.

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DISCUSSION

The discussion was opened by Mr. R. D. Emslie and Dr. D. M. Watt. In the general discussion that followed, Professor Matthews said it was quite obvious after hearing the papers that a periodontist was a necessary member of the staff of every prosthetics department. The papers had emphasized the grave responsibility the prosthetist has in exercising clinical judgement. With regard to the denture made in general practice, does the dentist know whether a denture is tooth-borne or tissue-borne? He believed that there was too great a mechanistic approach to partial denture construction. He disagreed with Mr. Anderson on the acrylic lower denture—the crux of the matter was the way in which the material was used. Mr. Thomson expressed his conviction that some T.M.J. dysfunctions arise through lack of function, and that it is difficult to know whether to instigate function or not in some cases. With regard to retainers on partial dentures, he felt that they are a good initial measure, but may be dispensed with later when other retentive forces take over.

Mr. Cross asked: (1) With regard to the fitting surface of acrylic resin—is it considered wise to polish? (2) Should dentures be left out at night? (3) What proportion of those present have got partial or even full dentures?

Mr. Ploughman also queried wearing dentures at night. All his partial dentures were made on a splint fashion—some with coverage of occlusal surfaces. With regard to caries incidence in these cases, choice of patient was important and a good stick technique was essential. Mr. MacGregor felt that as long as the Kennedy Classification was used there would continue to be damage to the gingivæ. He believed it was necessary to change to a classification by support. Gingival coverage in a tissue-borne denture led to much damage. Gingival coverage in a tooth-borne denture did not lead to damage.

Mr. Tinkler quoted personal experience of wearing a splint partial denture firstly in gold and latterly in chrome cobalt, which he wore at night because he felt uncomfortable without it. He provided this type of denture for selected cases, but he needed guidance on how to judge when an apparently clean mouth will become subject to rampant caries.

Mr. Wade asked: (1) If one decides to cover the gingiva does one relieve the model? (2) What are the relative merits of fixed bridgework and partial dentures?

Professor Mack advocated the use of all-acrylic dentures, the gingivæ being relieved with complete coverage of teeth up to or above the survey line, and the fitting surfaces foiled. Over a brief period there had been little evidence of mucosal irritation, and it seemed that less damage resulted than from routine gold or chrome cobalt dentures. Mr. Cura stated that one indication for replacement of the lost upper premolar is to prevent the first molar migrating mesially, with subsequent pocket formation. Metal bases were to be preferred to acrylic on account of the better polish obtainable on the fitting surface.

Professor Liddelow wanted more information on bone resorption. Alveolar response to load varied considerably, for in some cases there appeared to be no change in occlusion (representing no bony change) after several years, whereas in others there might be marked change after a few months. Does bone go on resorbing indefinitely? Is there a relationship to previous periodontal disease?

Professor Ganley asked, Do we extend into the gingival crevice or not? Mr. Lawson spoke with regard to food stagnation and the fallacy that by fitting the base closely to the teeth and gingivæ the accumulation of debris was prevented. Therefore, is the aim to get as perfect an adaptation as possible or rather to try to provide a really self-cleansing space?

Mr. MacKenzie advocated extraction of teeth and insertion of partial or full dentures where a severe periodontal condition exists. If there is active resorption going on, then this will continue post-operatively. Dr. Fox reviewed his work with Marsland. If periodontal disease has existed prior to extraction it is necessary for this to be cleared up prior to insertion of dentures. He stated they had found an excess of nervous tissue present, resembling amputation neuromata. This, together with bony irregularities, would produce pain on application of load. Dr. McHugh asked, What evidence is there that there is any pathological change in tissues after removal of periodontally involved teeth? Orban has suggested that periodontal disease usually only destroys alveolar bone and not basal bone. Are we right in advocating early extraction of teeth in periodontal disease?

In reply, Mr. Anderson referred to work by Copland showing that loss of functional support can lead to T.M.J. dysfunction. His opinion was that the partial denture should be either very close to, or far away from, tooth and gingivæ giving an adequate self-cleansing space. He agreed that acrylic is not always contra-indicated as a partial denture base, but that it is weak, the achievement of a smooth surface is difficult, and the addition of metal components is expensive.

Dentures generally should not be worn at night. The areas of base material covering the gingivæ should be slightly relieved, either by use of a smooth stone or by tinfoiling the fitting surface. He believed that immediate dentures tended to reduce ridge resorption, and that the amount of post-operative resorption depended to a large extent on the extraction technique. He quoted Radden's work which showed that healing was enhanced if the cortical plates were retained around the socket.

Also in reply, Professor Hopper said that, in reference to splinting, mouths during the war had cap splints in situ for 6 months. The teeth were firm after removal of the splints, although there was some gingival inflammation which rapidly cleared up. He agreed that there was no evidence to support the view that where periodontal disease existed there would continue to be rapid bone resorption after extraction.

MAINTAINING ORAL HEALTH*

By G. A. CUTHBERTSON, H.D.D., L.D.S., D.D.S.

PERIODONTOLOGY is the science and study of the periodontium and periodontal disease—the periodontium in health as well as disease—and a common conception of the dentist practising periodontics is that of complicated and time-consuming operations bogging the poor man down in a last-ditch effort to save hopelessly involved teeth. We have heard papers and discussed many aspects of the subject—aetiology, pathology, diagnosis, treatment, and prevention. From all this it emerges that our ultimate aim must be not just the prevention of periodontal disease, but, to take it a stage further, the maintenance of oral health. Now, what is the state of oral health as it affects the supporting structures in Great Britain to-day? The short answer is that we do not know.

There is a need for a comprehensive epidemiological study in this country to show the prevalence of periodontal disease. Such studies have been made in the United States and Canada, and over the past few years a group of workers in India have been studying the incidence of periodontal disease in the younger age-groups. The outstanding fact which emerged from these studies was that periodontal disease appeared much earlier than one might have thought. It is also more prevalent in the East than the West, but even in America there was a rise in the prevalence of gingivitis up to the age of puberty. By 25 years of age nearly 50 per cent were affected, and at 40 nearly 100 per cent of individuals had detectable evidence of periodontal disease. In this country we know that in the year 1958 well over three million courses involving periodontal treatment, mostly in the form of scaling and gum treatment, were provided under the General Dental Service. We also know that this involved a cost to the Exchequer of over two million pounds. What we do *not* know is the therapeutic value of these courses in view of the fact that, in the age-group 45 years and over, the number of full upper and lower dentures supplied comprise 30 per cent of the group, whilst periodontal treatment was provided for only 37 per cent of the group. It has been said that the present system encourages "tartar flicking" and "cosmetic polishing". These figures would seem to give some indication of the therapeutic value of such procedures.

Why do dentists turn their backs on the need for periodontal treatment? This is not generally accepted as one of the more glamorous aspects of dentistry; and dentistry, let us admit it, does not rank in the public estimation with the more spectacular, death-defying role of the handsome heroes of "Emergency Ward 10", and other sagas of the cinema and television screen. Thus your periodontist tends to be the quieter, more thoughtful type. Not for him the excitement of dextrously delivering a completely buried third molar, or clearing a mouthful of teeth in four minutes flat without a thought for the next move in the game. These accomplishments he leaves to the more rugged extroverts of our profession. Nor can he be afforded the immediate reward of a reconstituted smile and rehabilitated bite—both guaranteed to earn him at least a modicum of praise at any cocktail party. Because he has to search for the truth in an undramatic situation, spend a lot of time diagnosing and treating a condition with undramatic symptoms, it is perhaps understandable that many men should not feel the urge to complicate their lives still further. But if every dentist were to ask himself honestly how best he could maintain or improve his patients' oral health, the crystallization of his thoughts will inevitably be reflected in his handling of, and regard for, the supporting tissues of the teeth. These basic structures should dictate his entire method of patient handling and treatment planning.

* Presidential Address delivered to the British Society of Periodontology on Oct. 10, 1960.

Although this has been described as a specialist society, it is, in fact, not so. The majority of our members are general practitioners who should be conscious of the importance of periodontics. But we are fortunate as well to have among them a very strong nucleus of teachers of periodontology. Some of these latter do restrict their part-time practice to periodontics, and they are in great demand. Specialists are urgently needed, but by the very nature of their work they will be called on to treat the well-established and difficult cases. It is unlikely that we shall see in this country a great increase in the number of full-time practitioners limiting their practice to periodontics. In America the present trend is in the opposite direction, and figures taken from annual editions of the American Dental Directory show that periodontists were the only speciality group to decline in numbers between 1952 and 1958. On the other hand, the numbers of dental hygienists graduating each year in the United States had increased, although the Council on Dental Education of the American Dental Association is of the opinion that the number entering dental hygiene each year just about equalizes the number leaving. Even so, the number of active dental hygienists is now about 7000, and if the total number of dentists is taken as approximately 100,000, the proportion of 7 per cent is more than three times greater than we have in this country.

Our National Health Service is now 12 years old, and one of the principles on which the dental service was launched was the conservation of teeth. Comparatively attractive terms are offered for filling rather than the extraction of teeth. The more caries is controlled by conservative and preventive methods (including fluoridation) the greater will be the incidence of periodontal disease in the years to come. Increased longevity of the population will also result in more people surviving into the age range where the morbidity of periodontal disease is highest. The question which arises then is—Can the service now be brought to a position in which the conservation of the supporting tissues of these filled teeth becomes the main priority?

Research may provide a key to the answer. The past decade has seen enormous developments in the field of atomic physics and electronics and now we seem to be on the threshold of a biological revolution. Perhaps sooner than we might have hoped, the empirical and mechanical approach to our therapeutic problems will be enlightened by fresh knowledge in the fields of microbiology, pathology, and pharmacology. The study of the basic life forces within the cell must eventually lead to a better knowledge of its behaviour and that of the tissues it comprises. Some excellent work on epithelial growth has been presented to this Society by Professor Cohen and Dr. McHugh and we can hope that, in the near future, we may come nearer to an understanding of the metabolic factors involved in the aetiology of periodontal disease. But this is for the future, and for the present we must come back to the general practitioner and his public. If in our present, so-called "highly civilized", state we cannot eliminate dietary deficiencies or restore the primitive balance of exercise, partial attrition, and natural scavenging, we must accept and deal with the flaccid state of the oral mechanism.

The dentist in general practice is in an ideal position to see the development of the dentition, to anticipate trouble, and to direct home-care into the right channels. Periodontal break-down can be prevented if we reduce the environment in which we know it to flourish. This does not only mean the orthodontic regulation of children's teeth but the early correction of mouth-breathing habits and instruction in oral hygiene. Recent research has shown that the initial break in the interdental epithelial structures takes place very early indeed—in fact in the period immediately following tooth eruption, when the oral stratified squamous epithelium has to bridge the gap between the buccal and lingual papillæ, replacing the weak, reduced enamel epithelium. If damage occurs before this has taken place then the familiar detached papillæ of incipient periodontal disease are established and intra-bony pockets begin to form very soon afterwards. Treatment here should be aimed at encouraging good

epithelial growth completely through the interdental space.

In early adolescence the struggle against caries is intensified, but if the flood is dammed by hurriedly placing badly-contoured restorations the subsequent damage can only be corrected by, at the very least, replacement of these restorations. We must face the fact that many cases of periodontitis simplex in middle age are caused by overhanging margins and inadequately contoured restorations of ten to twenty years' standing—in other words, unimaginative dentistry.

The busy years of middle life, when according to Alexander Woolcott everything of interest is either illegal, immoral, or fattening —these are the years when we first see signs of wear, and occlusal trauma plays an aggravating part. If we now have to correct occlusions and replace missing teeth with bridges, the most important question to be answered before embarking on treatment must be: "Is this procedure going to benefit rather than burden the supporting tissues?" If the answer is negative, we are laying in a store of future trouble.

Geriatric periodontics could be the subject of an interesting paper. In the autumn of life one can perhaps forgive a slackening off in the enthusiasm for strict attention to hygiene—it is difficult to teach old dogs new tricks. But as the teeth exfoliate at Nature's speed much can be done by splinting and intelligent partial denture design to support lame teeth. Occlusal correction can be more radical. Let us never forget the great physical and psychological advantage which the elderly person, with a majority of his own teeth, enjoys over his edentulous cronies.

Now how does this work out in practice? In the first place the complete organization of the practice must be directed towards making such a service possible. This means that the economic factor, in so far as it affects the operator's time, must be adequate. No dentist is going to be happy in one aspect of his work if he has to subsidize it with another. At the same time, the patient must feel that he is receiving an adequate service. New patients must be instructed in the importance of obtaining and maintaining oral health, and I think this is the rock on which many of us founder. It takes two to make a bargain and, if the dentist is enthusiastic, it is contagious. If he is lukewarm, he is beaten before he starts. After a careful examination he should be in a position to tell the patient, as simply as possible, the present condition of his mouth, what treatment he advises, and how much it will cost.

Now we all know that patients vary in their attitude to treatment. Some are enthusiastically co-operative. They believe that loss of natural teeth is not inevitable and are determined to do their part in keeping them. Others, although well aware of the principles of nutrition and hygiene, start off with the best of intentions and then fall by the wayside. A third type only appears when forced to do so by emergency. They are lazy, they have dirty mouths, and they are content to stay that way.

It is a fundamental mistake to embark on treatment for the dentally uneducated patient. How do we find out? Trial and error would seem to be the only method. The best thing that has happened in general practice in the past few years has been the employment of a dental hygienist. Her chairside duties are not only to scale thoroughly and polish teeth but to teach the principles and demonstrate the practice of oral hygiene. She keeps her own records, arranges her own recall system, and checks on such things as the fluoride content of the drinking water in various districts. She is not responsible for the examination of the patient and her records are mainly a check on the rate of calculus formation, type of calculus, and general state of oral hygiene.

The regularly attending co-operative type of patient should be examined when she has completed the prophylaxis. This can be quite a short visit, and if further treatment is necessary, as revealed at the time or by subsequent examination of radiographs, further appointments are made.

Patients in the second category, that is, those who have not kept up their own efforts, should be seen at alternate appointments.

They need encouragement in the form of a "pep-talk". The important thing is that we must not clean teeth as a personal service, like a barber shampooing hair, but only as a means of creating an interest in oral hygiene. It should be constantly impressed on the patient that our time is valuable and that while we are anxious to help them maintain the hygienic conditions established, it is the daily ritual of home care which alone will ensure oral health.

With the third class one can only be a prophet of doom. But even this can be done in a friendly way and, like water dripping on a stone, it may eventually have some effect. These are not the types to be handed over by the dentist to his hygienist. They will only discourage her and make her feel that her room is the dumping ground of the practice.

The actual method of prophylaxis could be the subject of a full paper, but a few points may be mentioned. With the latest tungsten carbide hand instruments we have almost permanently sharp hoes and curettes with which to plane root surfaces. A disclosing solution is invaluable for demonstrating the bacterial plaque on tooth surfaces. Basic fuchsin stock solution has the great benefit of being non-toxic and not staining silicate fillings since it dissolves in saliva and disappears in a few hours. Seeing is believing, and most people are amazed when their hitherto invisible slimy materia alba suddenly appears before their very eyes. Careful examination of radiographs will show spurs of subgingival calculus, fillings with overhanging margins, ill-shaped contact points, and badly formed embrasures. Polishing with brushes, rubber cups, and pastes can be supplemented by the use of tape, and it is appreciated by the patient if the loose paste is flushed away with tepid water from the syringe. It is in the clinical examination of the gingivæ themselves, however, that the earliest signs of periodontal disease can be found. Minute changes in colour, contour, and texture are the warning signs of future trouble and if these are noted it is gratifying to see how they resolve when the causative agent has been removed.

It has been said that gingivectomy is a quick way of reducing inflammation and pocketing, as opposed to intensive scaling. This is a generalization which is only partly true. There are many established cases where surgery is absolutely necessary, but equally there are very many cases which at first sight appear worse than they are, and where such general methods as packing and scaling, designed to promote repair in the periodontal tissues, produce results of greater permanence, because in achieving them an essential prerequisite has been the patient's own participation in his treatment. The patient must be taught that *he* is the only one who can prevent a relapse. Only when he has experienced a really clean mouth, free from calculus and plaque, can he have a yardstick to measure the effects of his own efforts to maintain and stimulate it with his own equipment. Depending on the condition of the mouth he must be taught the use of the various wood points, interdental tape, mouth-brushing with paste and sodium bicarbonate, as well as rinsing or spraying.

It would be naïve to expect the already over-burdened practitioner under the present terms of the health service to be entirely responsible for the oral hygiene education and periodontal treatment of all patients under his care. The load must be shared by others, and, to my mind, delegation to ancillaries is the only answer.

So far as education of the public is concerned the Oral Hygiene Service plays a most enlightened part in furthering dental health in this country. This, however, is one body with one voice. Other voices are heard from the General Dental Council, the Ministry of Health, the B.D.A., and now a new committee under the chairmanship of Lord Cohen of Birkenhead has been appointed to carry the study of health education further. It would appear, however, that there is still insufficient impact on the public mind. It may be that the public, already saturated with slogans, is becoming immune to the hitherto accepted methods of education, and that in the field of oral hygiene more emphasis should be placed on subtler methods in which

the more personal and social aspects are considered. There is real need for a systematic analysis of the problems of maintaining oral health. When we consider that one person in three in Great Britain does not own a toothbrush and that many who do make them last for over a year before renewing them, it can be seen that all aspects of need, social behaviour, and buying habits, need reappraisal. In educating and treating individuals, the experience of practice leads to the conclusion that a great increase in the number of dental hygienists would be of immense benefit. If the single-handed practitioner felt unable to employ his own hygienist, but realized the need for help, he might feel that treatment at an oral hygiene clinic would answer the purpose.

During the present acute shortage of dentists the main object of public health dental education is to reduce the amount of dental disease which has to be treated. This will inevitably lead the public to demand a service which at present cannot be provided. Surely in the field of preventive dentistry it would be more feasible to produce a force of trained dental hygienists than to increase the number of dentists to deal with the greater demand which would follow an adequate educational programme.

By its very nature this Society is more academic than political, but I submit that, be it only in an advisory capacity, we have individually and collectively a responsibility in the maintenance of oral health. Government departments tend to become absorbed with quantity, rather than quality, and to-day, more than ever before, it is the quality of our contribution to the nation's health which is in danger of being stifled.

To sum up: Quality and service are the two main attributes which periodontology demands in dentistry; it is my hope that this Society will play its part in promoting these very positive factors towards maintaining oral health.

PRIMARY AMYLOID DISEASE

Amyloidosis may occur as primary amyloidosis in which the deposits form in muscle, secondary amyloidosis which is associated with chronic suppuration and certain other diseases, and in which deposits infiltrate the viscera, tumour-forming amyloid producing solitary or multiple masses, and amyloidosis associated with myelomatosis. The features of primary amyloidosis are briefly reviewed.

Following the extraction of $\overline{8}|$ two years previously, a negro woman aged 50 developed blood-blisters on the gums followed by nodules in the lips, swelling of the face, enlarged cervical lymph-nodes, abdominal discomfort, and a stuffy nose. In spite of various treatments she lost weight and when first seen had granulomatous lesions of the gingivæ, nodules in the lips and on the palate, enlarged salivary glands, and swollen lymph-nodes. The eyes were red and she was photophobic. Numerous subcutaneous nodules were present, and X-rays of the jaws showed areas of bone loss. The heart was not enlarged, but the spleen was palpable 3 finger breadths below the costal margin. Following biopsies of the gingival lesions, lips, and skin a diagnosis of amyloidosis was made.

Six months later she complained of pain in $\underline{8}|$ region. The tuberosity showed an area of bone loss on X-ray examination and when $\underline{8}|$ was extracted a biopsy was made of the overlying gum. This was infiltrated with amyloid. By 9 months from the time when she was first seen she was weak, had dry, cracked lips, and was bleeding from the oral lesions. The nodular masses were larger and weight-loss progressive. She died a year later. Post-mortem examination confirmed the clinical diagnosis of primary amyloid disease.—WARE, W. H., and SILVERMAN, S., JUN. (1961), *J. oral Surg.*, **19**, 140.

G. R. SEWARD

[The original article, with one by B. D. Gold in the same journal, are recommended to those unfamiliar with amyloidosis.]

BOOK REVIEWS

DENTAL HEALTH EDUCATION for Dental Health Educators in School and Community Dental Health Programs, with special consideration for the Education of Adults during Dental Treatment. By FRANCES A. STOLL, R.D.H., Ed.D., Professor of Dental Hygiene, Director of Courses for Dental Hygienists, Columbia University. Second Edition. $9\frac{3}{4} \times 6$ in. Pp. 253, with 41 illustrations. 1960. London: Henry Kimpton. 41s.

THIS book has been "thoroughly revised". It is intended for dental health educators, classroom teachers, and dental hygienists. In general, the extension and revision of the text are an improvement. Naturally the book is intended for American readers who will readily appreciate the background of their own community and the levels of application of the material presented.

Chapters 2 and 3 aim to give sufficient basic knowledge for the readers to understand the dental health measures which are employed. The former chapter is concise and effective but could be improved by better illustrations. It is surprising to find so much prominence given to the tests for caries susceptibility in Chapter 3, for these tests are not widely accepted as applicable to individual patients.

In Chapter 5 the philosophy of the education of children is discussed and many useful points are stressed. For example, Professor Stoll insists that sugar drink dispensing machines and candy bar dispensers have no place in school. Pertinently, she says that when dental health educators propose a ban on the sale of these items on school premises much opposition is raised. It is claimed that the children will be exposed to the risk of traffic accidents as they run to "the shops around the corner". She points to the great uproar which would arise if cigarette dispensing machines were placed in the school. The responsibilities of teachers and parents in dental health education are dealt with in detail and are worthy of study.

An interesting section of the book lies in Parts III and IV, where the techniques and methods of dental health education are discussed. This is a valuable contribution and a useful *aide-mémoire* to those who seek to plan such measures.

It is disappointing to find in this well-bound and printed book a set of illustrations which do little to heighten the text. Several illustrations, taken from other sources, for example those illustrating the use of a famous waxed cup, were without point. However, the text is well tabulated and laid out carefully to break up the reading matter.

This book has not a general application in this country but could serve as a useful reference for those planning dental health education.

G. L. S.

ANESTHÉSIE RATIONNELLE EN ART DENTAIRE. By Dr. ANG S. SARGENTI. 9×6 in. Pp. 103, with 48 illustrations. 1960. Paris: Librairie Maloine S.A. 15 N.F.

THIS is a concise monograph in which the author clearly and systematically describes the use of local anæsthetics in dentistry.

He begins by describing briefly the more commonly used local anæsthetic solutions, their various concentrations, and names the vasoconstrictors added to obtain the best results.

The author then gives details of the cartridge type of syringe, the requirements of a good needle, and its proper sterilization. The injection technique for each tooth is reviewed in conjunction with the use of surface anæsthetics, and valuable suggestions are given for avoiding failure of anæsthesia in the mandibular nerve.

He concludes by describing the complications that may follow an injection and how to deal with them.

There are 48 clear and self-explanatory illustrations in this booklet. It should be useful to the practitioner as well as to the dental student.

J. M. J. L.

[*Other Book Reviews appear on page* 76.]

SUPERNUMERARY TEETH

By **J. H. GARDINER**, B.D.S., D.Orth.R.C.S. (Eng.)
Senior Lecturer and Head of the Orthodontic Department, Sheffield Dental School

SUPERNUMERARY teeth are commonplace, for, as early as 1771, John Hunter stated: "We often meet with supernumerary teeth, and this, as well as some other variations, happens oftener in the upper than in the lower jaw", and it must be the experience of most who practise children's dentistry. Desirabode (1847) reports the case of a servant of a physician to the Hôtel Dieu who had over forty teeth in all. Bellinghausen (1955) more recently describes a patient having over thirty supernumerary teeth. Teeth extra to the normal complement have been found in the earliest remains of man (Weinberger, 1926) and have been recorded in dental literature since the days of Paul of Aegina in the seventh century A.D. Over fifty cases were recorded in dental literature between 1850 and 1900, and in the last ten years over thirty cases have been published, but these, naturally, only represent a fraction of the cases presenting for treatment.

FORM

"The form of supernumerary [teeth] is very different from that of any of the other classes of teeth", was stated by Joseph Fox in 1803, and his description of these extra teeth could well be repeated to-day: "they are generally small round teeth resembling the point of a quill, and sometimes they are not much unlike bicuspis of the under jaw". Blake (1801) also describes "the bodies and roots of the lateral temporary incisors and cuspidati joined together", and "the middle and lateral incisors were so intimately united that on viewing them externally they appeared as one large middle incisor"; also "I have sometimes observed a supernumerary tooth, firmly attached to a grinder".

There is no doubt that it is the appearance of some of these supernumerary incisors, or their sequelæ, that cause some patients to seek treatment.

TERMINOLOGY

Tomes (1897) suggested that these supernumerary teeth resembling normal teeth be called "supplemental teeth". An idea of their incidence is given by the fact that out of 100 cases of extra teeth treated at the Sheffield Dental Hospital, 23 had what Tomes would call supplemental teeth, 74 had the conical or multicuspid form, and 3 cases had both supplemental and supernumerary teeth. Bolk (1914) gives the name "mesiodens" to a supernumerary tooth occurring in the upper midline, "paramolar" to those occurring in the interproximal space buccal to the upper second and third molars, and "distomolar" to any fourth molar lying either directly distal or disto-lingual to the upper third molar.

INCIDENCE

The incidence of the separate supernumerary teeth appears to be constant. MacPhee (1935), in a visual examination of 4000 Glasgow schoolchildren, discovered 12 *erupted* supernumerary teeth—an incidence of 0·3 per cent.

Dolder (1936), in 10,000 Swiss schoolchildren, found a similar incidence, as also did Tinn (1940) in 8500 Yorkshire schoolchildren. In 1000 Sheffield schoolchildren (Gardiner, 1956) a similar incidence of erupted supernumerary teeth was found, and Stafne (1932) also gives the same figure for erupted supernumeraries, but, having made a full-mouth radiographic examination of 48,550 persons, he found that the *total* incidence (i.e., both erupted and unerupted) was nearer 1 per cent. As regards the incidence of cases actually presenting for treatment in a Dental Hospital,

Given at the meeting held on February 13, 1961.

we have found in Sheffield that, taken over a 10-year period, out of a total of 2250 patients treated for malocclusion, 100 or 4½ per cent had extra teeth.

In certain conditions the incidence of extra teeth is much higher, e.g., in 60 cases of cleft palate Millhon and Stafne (1941) found the incidence of supernumerary teeth to be 37 per cent, and in 40 orthodontic patients having cleft palates in Sheffield the incidence was 42 per cent. There also appears to be a higher incidence in patients having cleidocranial dysostosis (Payne, 1930; Chipps, 1951; and Brash, 1956).

COMPARATIVE ANATOMY

Bateson (1892) from his study of 3000 animal skulls found extra teeth to occur more frequently in domestic dogs, anthropoid apes, and seals, and Hübner (1930) observed that monkeys frequently have four molars, whereas they only rarely have extra anterior teeth and almost never any extra premolars.

SITUATION

As regards the situation of extra teeth in humans, Stafne (1932), in his very complete study, found the distribution of supernumerary teeth in persons who were mostly adult to be as shown in *Table I.*

Six of the Sheffield patients were found to have inverted supernumeraries, but Stafne found that 114 out of 200 supernumerary teeth in this region were inverted, i.e., their crown directed towards the nares, and 4 cases are reported where the extra tooth has, in fact, erupted into the nasal cavity. These inverted supernumerary teeth appear to have a more definite canine-like crown than the conical mesiodens. In the adults especially, there was evidence of the decalcification and *absorption* of these inverted supernumerary teeth, i.e., in 24 of Stafne's patients and 4 of Morgan's 50 adult patients. Flint (1939) claims that their decalcification does not occur under 35 years of age. Also 10 of Stafne's patients and 12 of Morgan's adult patients had cystic conditions associated with the supernumerary teeth.

In the lower central incisor region of all 10 cases Stafne found the extra teeth to be supplemental incisors, i.e., resembling normal central incisors, but in Sheffield the proportion was found to be higher, i.e., 3 supplementary lower centrals out of a total of 100 cases. Conical supernumeraries do, however, occur in this region (Stones, 1954).

Stafne also found, in the upper lateral incisor region, the extra teeth to be supplemental teeth resembling normal incisors.

Table I.—Stafne's Figures on the Incidence and Distribution of 500 Supernumerary Teeth

	Central Incisors	Lateral Incisors	Canines	Premolars	Paramolars	Fourth Molars	Total
Maxilla	227	19	2	9	58	131	446
Mandible	10	0	1	33	0	10	54

The upper incisor region of the mouth has the highest incidence of supernumerary teeth and the majority are the simple conical mesiodens. These very often occur in pairs, e.g., in 20 of Stafne's 180 patients, in 42 of Morgan's (1946) 100 patients, and in 20 of the 100 Sheffield patients. In only a proportion of cases are the supernumeraries *erupted*, e.g., 21 of Stafne's 180 patients and 18 of Morgan's 100 patients.

Other observers report the same (Munro, 1952; Townend, 1953; and Brown, 1954), each of these latter cases having been preceded by supplemental deciduous lateral incisors. In Sheffield, out of 25 patients presenting with supplemental teeth 18 occurred in this upper lateral incisor region and 4 were known to have been preceded by supplemental deciduous laterals. Stafne did not report finding any extra teeth in the lower lateral incisor region.

In ten years in Sheffield 4 cases have presented, and Rose (1954) found 1 among 32 cases of extra teeth. The explanation may be that Stafne conducted his survey upon a mixed adult and juvenile population and that any extra lower incisor had already been extracted.

In the canine regions, the incidence of supplementary teeth is comparatively rare. Out of 48,550 persons, Stafne could only find 3 supplemental canine teeth, 2 being in the upper canine region and 1 in the lower. Fastlicht (1943) and de Jonge (1948) report symmetrical duplication of both upper permanent canines, and Oehlers (1950) reports the unilateral duplication of an upper deciduous canine. Over a period of ten years in Sheffield, we could only find 1 case with 3 unerupted upper supplemental canines and 1 other case with an erupted supplemental lower canine. Stafne, however, found a greater incidence in the upper and lower canine regions of diminutive teeth or denticles, occurring either in groups or singly, and also compound composite odontomes. He reports upon 50 such cases. Ottolengui (1931) and Ribble (1931) also report on similar cases. Two cases have presented in the Sheffield orthodontic department.

Extra teeth in the premolar region occur more commonly in the mandible, where they are almost always supplemental premolars. In the upper premolar regions a conical supernumerary tooth sometimes occurs. The majority of reports in the dental literature upon extra teeth in premolar regions concern patients from the East or from Africa. Still (1945) reports several cases and states that in Southern Nigeria approximately one person in every hundred has one or more extra premolar teeth.

Small conical supernumerary teeth occurring mesiobuccally to the upper third molar and sometimes the upper second molar were first described and named paramolars by Bolk (1914). They are sometimes fused to these upper molars.

Fourth molars or distomolars, as Bolk called them, can either be conical or resemble small molars. They occur either directly distal or distolingual to the upper third molar. Hendler (1935) reports 4 cases and explains that these would be observed more frequently, but for this area lying beyond the limit of the ordinary upper molar radiograph.

In addition to the situations already mentioned, supernumerary teeth sometimes occur in more remote areas. Goldman (1949) reports a patient having a supernumerary tooth upon the anterior wall of the right maxillary sinus. Fastlicht (1943) shows a

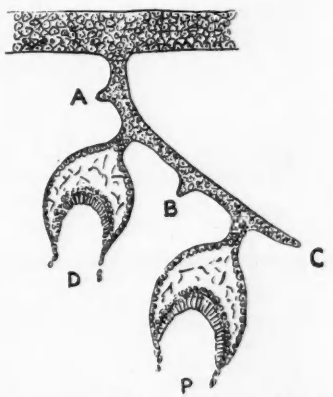

Fig. 1.—A developing tooth-band showing the situation of: deciduous tooth germ (D); permanent tooth germ (P); site of pre-deciduous type of supernumerary tooth (A); site of more common type of supernumerary (B); and site of post-permanent type of supernumerary (C). (*After E. Sprawson.*)

conical tooth in the floor of the nasal cavity in a pre-Columbian Indian skull, and Thomas Bell (1829) writes of "a cuspidatus, or a supernumerary tooth resembling it . . . projecting into the right nostril, to the extent of three quarters of an inch".

De Lapersonne and Monier (1924) report upon a girl of 15 years who had twelve or more small supernumerary teeth protruding through the sphenomaxillary fissure into the orbit.

AETIOLOGY

Various theories have been advanced to explain the origin of these extra teeth: (1) Atavism; (2) Excessive growth of the dental lamina; (3) Proliferation of remnants of the

dental lamina; (4) Dichotomy of the tooth germ; (5) Heredity; (6) General conditions.

1. The theory of atavism (the recurrence of the ancestral forms of teeth which have become extinct) is not now held so strongly, as, in the case of supplemental canines for instance, it has been shown that there never have been more than four canines in the mammalian dentition.

2. A more favoured theory is that of excessive growth in the epithelial tooth-band or dental lamina (*Fig.* 1) as put forward by Black (1909). Abnormal proliferations could arise at point A giving rise to the pre-deciduous type of supernumerary "tooth", sometimes seen upon the mandibular gum pads of the newborn child in the incisor region as horny structures which are usually shed after the first few weeks of life.

The more common type of supernumerary tooth could arise at point B. If situated too close to the regular tooth germ it may become fused to it. The post-permanent type of supernumerary tooth could arise at point C. Evidence of the development of post-permanent supernumerary teeth is provided by Marré (1940), Adelstein (1943), Oehlers (1952), and Cowan (1952), who show partially developed extra premolars *after* the regular premolars have completed their root formation.

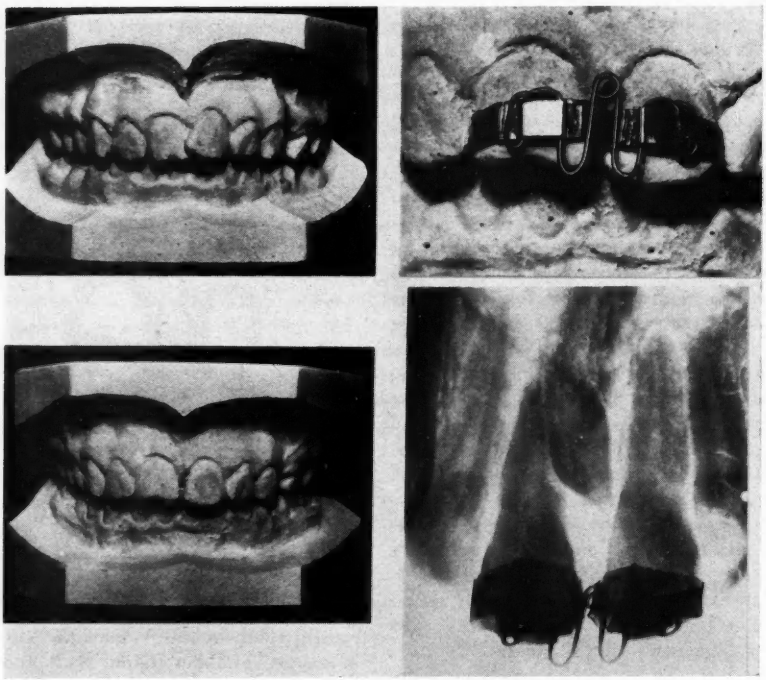

Fig. 2.—Relapse in treatment due to unobserved unerupted supernumerary tooth.

3. Black also stated that groups of epithelial cells left after the breaking-up of the epithelial cords could, as a result of unknown stimulating conditions, develop into the tooth germ of a future supernumerary tooth. Zukerkandl (1929) reported that about 3 per cent of crania examined by him were found to

contain enamel-less tooth rudiments in the incisor regions.

4. Yet another theory is that a tooth germ may undergo dichotomy. If the division is equal, the result is a supplemental tooth resembling the normal series, but, if unequal, the additional tooth might be malformed and conical.

5. Heredity has been put forward as another explanation of supernumerary teeth. Stafne (1931), in his very complete survey on the subject, states: "A sufficient number of persons gave histories of the same abnormality having been seen in other members of their families to corroborate the belief that it has a hereditary tendency to occur. . . . The form and position of the teeth of various relatives were almost identically the same." Flint (1939) and Payne (1930) also found that case-histories show heredity to play a part. Similar conditions were found in a sister and a brother aged 9 and 10 years respectively and in two brothers aged 10 and 12 years.

6. General conditions: It is generally admitted that some general diseases can affect the tooth germ and a higher proportion of supernumerary teeth are found in such conditions as cleido-cranial dysostosis (Payne, 1930; Chipps, 1951; Brash, 1956) and cleft palate (Millhon and Stafne, 1941).

DIAGNOSIS

Undoubtedly the prime requisite in the diagnosis of unerupted extra teeth is a good radiographic examination, as is shown by the case illustrated in *Fig.* 2. The patient presented with a slight overlapping of the upper central incisors. After treatment and retention the case relapsed twice. Radiographic examination showed a small supernumerary tooth to be lying across the apex of one of the incisors. After the removal of this extra tooth, treatment was then completed uneventfully.

Bartleman (1932) also emphasizes the need for complete radiographic examination in these cases and describes a case referred to him for the removal of two erupted supernumerary teeth in the upper incisor region, which turned out to have, in addition, six unerupted lower supplementary premolars and four unerupted upper premolars.

Hendler (1935) states that extra teeth in the molar region often lie beyond the area of the ordinary small radiograph. An occlusal view or even a stereoscopic technique (Strickland, 1945; Tulley and Campbell, 1960) helps to localize the position of these extra teeth. Possibly the most accurate information is

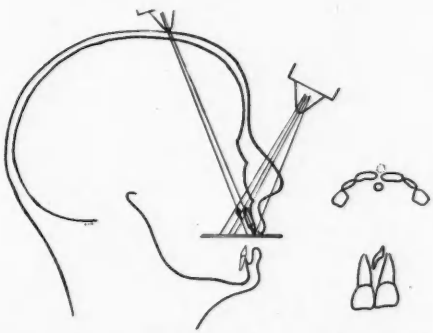

Fig. 3.—Diagram of a vertex occlusal and usual occlusal X-ray views. (*By kind permission of G. H. Roberts.*)

derived from a vertex occlusal view as described by Hitchin (1956) (*Fig.* 3), for in this view the X-rays pass along the long axes of the teeth and any extra body is shown either lingual or buccal to the arch.

SEQUELÆ AND THEIR TREATMENT

Supernumerary and supplemental teeth are not invariably accompanied by malocclusion. In at least 7 per cent of the supernumerary tooth patients in Sheffield there was no associated irregularity, but the anomalies commonly associated with these extra teeth are: (1) Bodily displacement of teeth of the normal series—42 per cent; (2) Delayed eruption of associated permanent teeth—28 per cent; (3) Rotation of the normal teeth—21 per cent; (4) Gemination or fusion—3 per cent.

BODILY DISPLACEMENT

There is no clearly marked division between these conditions, since all could occur in one patient, but certainly bodily displacement

was the most frequent, for it occurred in 42 of the 100 non-cleft palate supernumerary tooth patients presenting for orthodontic treatment in Sheffield. It was, as the name implies, a complete displacement of both crown and root to the same extent. The only a portion of the root being present. In all it took 7½ months to move $\underline{1}|$ bodily through 7 mm., whereas in this 17-year-old patient (*Fig.* 5) it took 5 months to move the $\underline{1}|$ through 3 mm. and the final adjustment and retention took a further 3 years.

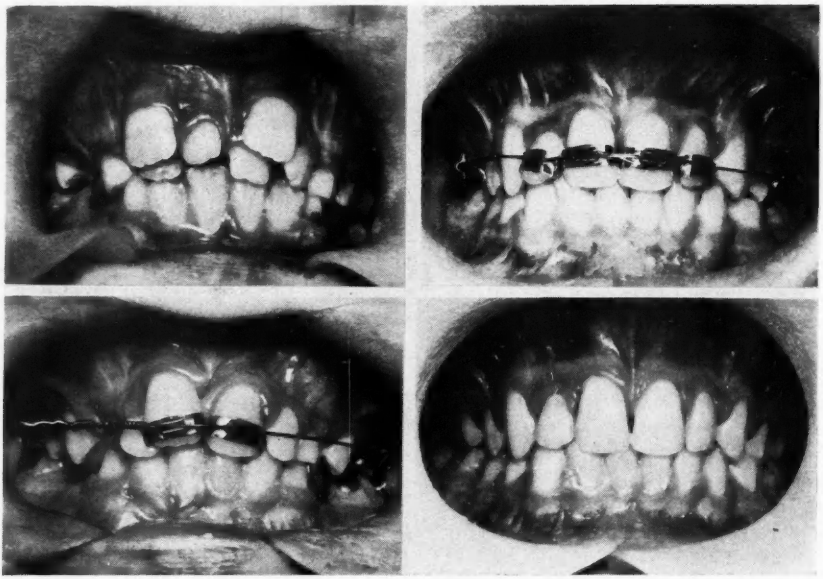

Fig. 4.—Stages in treating the displacement produced by two supplemental lateral incisors between $\underline{1|1}$ in a patient of 8 years.

explanation of this displacement may be that the forming crown of the normal permanent tooth was displaced from its normal path of development by the supernumerary teeth growing alongside it on the tooth-band or dental lamina.

John Hunter stated in 1771, "When there are supernumerary teeth, it will, in general, be proper to have them drawn". But in addition to extraction of extra teeth, there is the alinement of the displaced neighbouring teeth. In most cases this was achieved with helical springs upon a round or edgewise arch, as in this patient of 8 years (*Fig.* 4), thus having a reciprocal action in moving the displaced incisors mesially and the molars distally. In the case of this young patient, root movement was probably facilitated by

In a labiolingual direction, the normal incisors appear to be more often displaced labially by supernumerary teeth, and so when the latter have been extracted the incisors can be alined by the use of removable appliances.

DELAYED ERUPTION

Twenty-eight per cent of the supernumerary tooth cases in Sheffield were accompanied by delayed eruption of the upper permanent incisors and it was undoubtedly their appearance that prompted the parents to take action. Before attending the Dental Hospital, more than one of these patients had already been provided with a partial denture in the belief that the upper incisors were absent!

The first obvious point in treatment, following radiographic examination, is usually to extract the unerupted supernumeraries, though Stoy (1954) published some interesting findings. He showed by true vertex occlusal views that there may be no actual contact between the hard tissues of the unerupted supernumerary teeth and the unerupted central incisors, and that extraction of the supernumerary teeth alone does not necessarily result in the eruption of these incisors. If, however, the tissue overlying the incisal edges of the unerupted incisors is removed then, even though the supernumeraries are left in place, the incisors erupt. It would seem, therefore, that in addition to removing the supernumerary teeth it is also advisable to uncover the incisal edges of the unerupted incisors.

Following this, the next most important point is the provision of sufficient space, mesiodistally, in the dental arch. The incisors, following surgical exposure, usually erupt on their own, sometimes into surprisingly good alinement. So often, though, in these cases the erupted lateral incisors have drifted mesially and there is insufficient room for the central incisors. This can be provided with a simple finger-spring plate or a Badcock-type of screw plate, as described by Dickson (1959), and, in some cases, $\underline{4|4}$ may have to be extracted to facilitate the distal movement of the upper canines and lateral incisors. Where removable appliances are not advisable, a simple local fixed appliance can be used.

Upon full eruption, the incisors may not require alining, but if required, this can be accomplished with an apron-spring plate, the usual twin-arch (*Fig.* 6), or a single round-wire arch.

Occasionally one of the unerupted incisors is very much displaced or impacted and requires special consideration. In one such case, a spring operated by the patient upon a denture was used. When this right central had been moved sufficiently labially it was possible to use a facial arch disguised by a denture until a band could be made around it for traction in the ordinary way.

In another case, having made space in the arch with a local pin and tube appliance (*Fig.* 7), this latter was extended into the labial sulcus to retain a zinc-oxide/eugenol/cotton-wool pack and the tooth eventually banded and included in a round-wire arch.

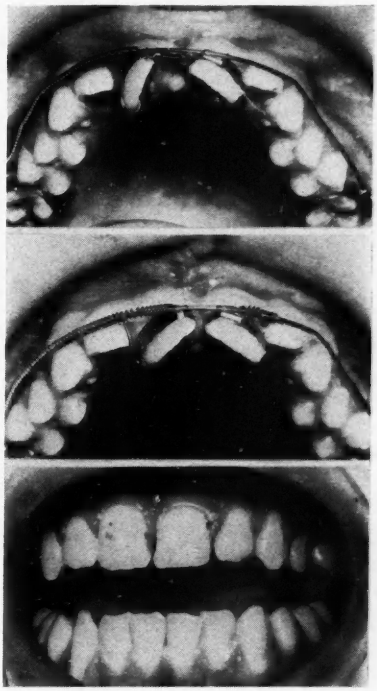

Fig. 5.—Stages in treating the displacement produced by two midline supernumerary teeth in a patient of 17 years.

More recently in a 9-year-old girl with a horizontal displacement of an upper central incisor a band was pre-formed upon the erupted central, then when the unerupted central had been uncovered surgically, it was cemented in place and a ligature carried through the flap to this multi-purpose 0·6 mm. round facial arch (*Fig.* 8). This arch served not only to widen the space but also to draw the unerupted central both occlusally and lingually until more orthodox arches could be employed.

ROTATIONS

In 21 of the 100 cases under consideration, the presence of supernumerary teeth was associated with rotation of the central incisors. These were treated almost entirely with fixed appliances such as the twin-wire and 0·45-mm. single round-wire arches. Whether Sheffield children are more boisterous with their appliances or not, I cannot say, but a high proportion presented with fracture of the wire staple attachment (*Fig.* 9 A) used when ligaturing a rotated tooth to a wire arch. A perforated tab made from 3·0 × 0·2 mm. soft tape was therefore developed (*Fig.* 9 B). The hole was drilled with a No. 1 carbide-tipped rose-head bur or the embossing produced by a rubber dam punch was stoned down. These were found to stand up to even the most boisterous patient.

One other problem which may be peculiar to Sheffield is the disinclination of girls above 13 years of age to have "any wire that shows in the front". One answer we have found in such cases where an anterior tooth is rotated is to carry a ligature from the band to an activated finger spring upon a lingual bow (*Fig.* 10).

The idea of the "whip" is, of course, well known, and usually consists of a short arm from a bracket on a band with its free end formed into a hook and latched over the facial arch which can be fixed or removable. Where a welder is not available, it is possible to utilize a cast silver cap upon the rotated tooth with the doubled wire pulled into a short tube cast with the cap (*Fig.* 11).

Having corrected these rotated teeth, their retention proved to be lengthy. Reitan (1958) showed that there was tension in certain fibres of the periodontal membrane even 7½ months after active rotation of the tooth had ceased. Clinically, we found it advisable, despite the protests of the patient, to leave the twin or other wire arch in position for at least 4 months after the tooth was corrected before considering a Hawley retainer or the spur type of retainer for a further 4 months; our decision depending upon our assessment of the likelihood of

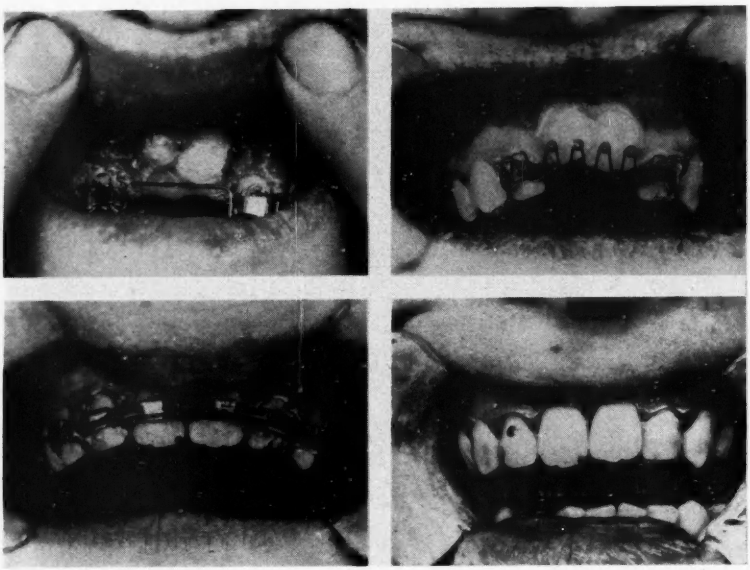

Fig. 6.—Stages in treating a patient of 14 years, the eruption of whose $\underline{1|1}$ had been delayed by supernumerary teeth.

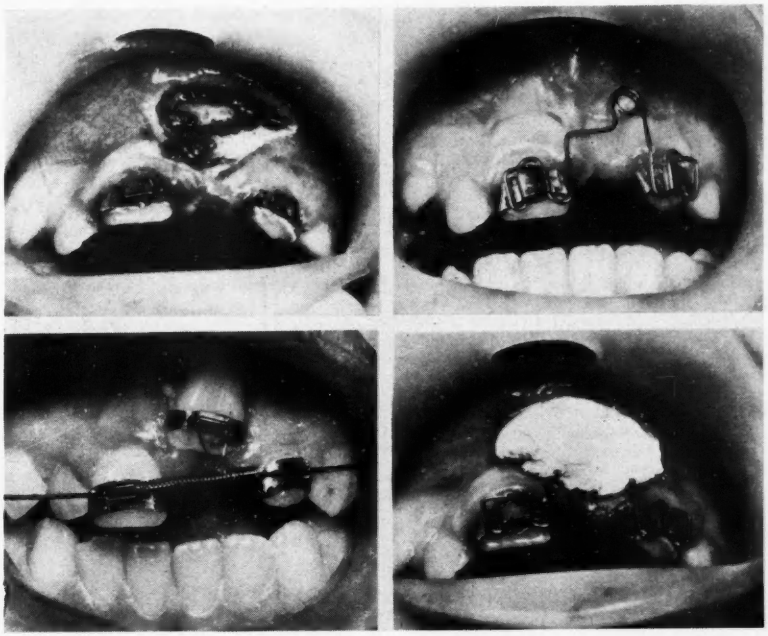

Fig. 7.—Creating a space for an unerupted central incisor whilst holding a zinc-oxide–clove-oil–cotton-wool pack in the sulcus.

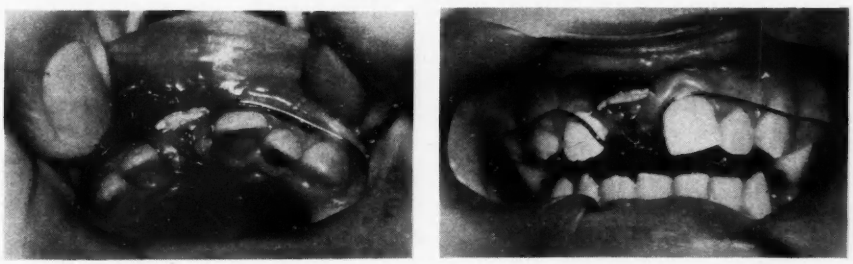

Fig. 8.—A multi-purpose round-wire arch (0·6-mm. diameter wire) for moving an unerupted upper incisor occlusally and lingually whilst creating a space for it anteriorly.

continuous contact between the removable appliance and the patient!

GEMINATION OR FUSION

The gemination or fusion of teeth was described by Blake as early as 1801, and in this present series in Sheffield was found to occur in 3 permanent teeth out of the 100 patients with extra teeth. Tinn (1940) reports a similar number in the permanent teeth of 8500 schoolchildren, but found 22 instances of fused teeth in the deciduous dentition. Others have made similar findings, e.g., Munro (1958) reports upon 31 cases of gemination in the deciduous dentition, 17 of these occurring in the maxillary incisor region and 14 in the mandibular incisor-canine region. He also reports that of the permanent successors to these geminated teeth, 12 were missing, 9 appeared normal, 6 were of

abnormal form, and 4 were associated with extra teeth.

Various explanations are put forward to account for this condition of gemination. Following Black's theory, it is conceivable that if an extra tooth forms on the dental lamina too close to the normal tooth, then it may become attached to it, and the degree of union will depend upon the stage of tooth formation reached when the two tooth germs come into contact. If this occurs in the very early stages, there will be complete fusion, but if the crowns have become partially formed then a clear line of separation exists.

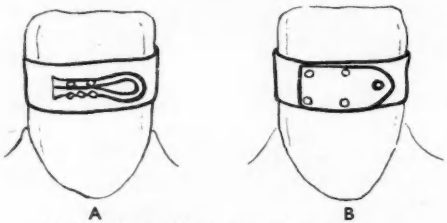

Fig. 9.—A "tab" attachment for rotating an incisor.

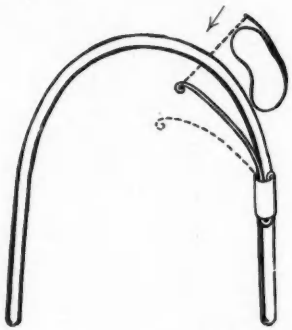

Fig. 10.—A short lingual finger spring and ligature for rotating an incisor.

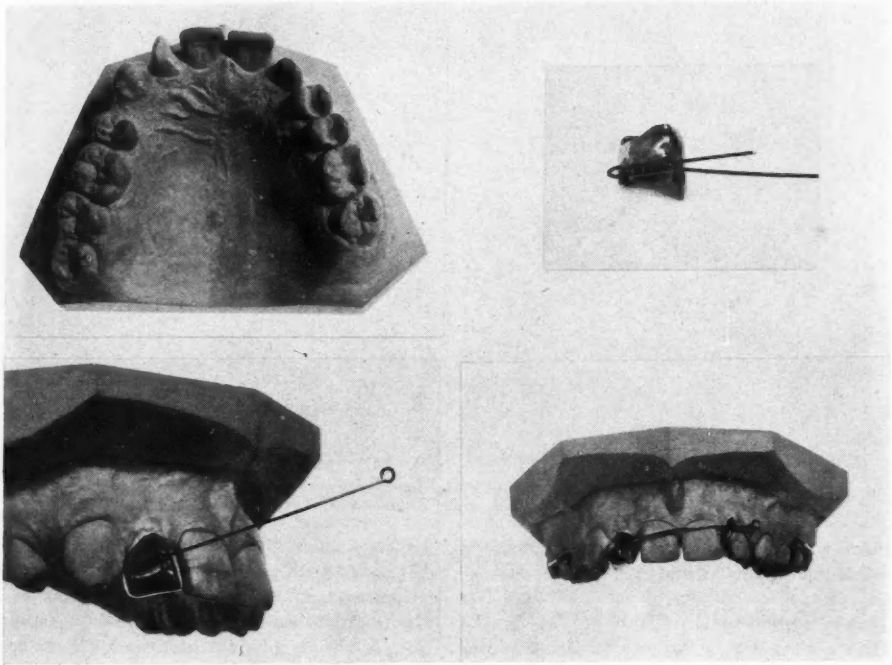

Fig. 11.—A cast silver cap and "whip" for rotating an incisor.

Most geminations occur either mesially or distally, producing a displacement of the neighbouring teeth. Where, however, an extra cusp occurs lingually it can cause a malocclusion in the opposing jaw. As a part of the treatment in such a case, we were proposing gradually to grind away this offending cusp and root-fill its canal if necessary, but the patient saved us the trouble by failing to turn up for her appointments!

Other forms of gemination are so complete that it is difficult to see any demarcation. Even this very wide central incisor had a common pulp with its adjoining supplementary tooth. The treatment in this case was to extract this wide central, approximate the neighbouring teeth by means of helical springs upon a twin-wire arch, then finally to add a jacket crown to the $\underline{|2}$. I recently saw this patient five years after completion of treatment and he seemed quite satisfied.

I have heard that with these giant-sized central incisors it is possible to disk a groove labially and incisally, darken this with silver nitrate, then add a triangular pink acrylic inlay at gingival level.

Acknowledgements.—I would like to acknowledge, with gratitude, the help I have received from Miss J. M. Kershaw of the Lindsey Library for tracing many of the references given in this paper, and for the loan of several of the lantern slides I would like to thank Professor Roberts. My thanks are also due to Mrs. Walkland for preparing *Fig.* 10, and to Mr. Cousins, of the Sheffield Dental Hospital Photographic Department, for all the photographs and lantern slide preparations.

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DISCUSSION

Mr. W. J. Tulley said that Mr. Gardiner had not really left very much for him to say. He would disagree on one or two small points. Mr. Gardiner had said that supernumeraries were commonplace. How many general practitioners saw a supernumerary tooth in a year? He did not think that they were commonplace in relation to the rest of malocclusions.

Mr. Gardiner had discussed the literature thoroughly, and it was always a great thing to listen to the words of John Hunter and Joseph Fox; there had not been a lot new since their day.

He thought that there were probably quite a lot more supernumeraries in the deciduous dentition which got by without necessarily being seen—certainly without being reported. In the surgical removal of supernumeraries, one should not be too premature. One should not remove them just because they happened to be seen on an X-ray in a child of 6 or 7, before the permanent incisors had had a chance to erupt. There was always the danger of taking out or damaging something other than the supernumerary.

With regard to occlusal traction along the long axis of those teeth, he thought that, where it was possible, it was far better to let them erupt on their own. He had seen teeth die by rather excessive occlusal traction applied to them.

He was intrigued with the method of masking a large geminated incisor.

Mr. Gardiner had shown one case where a supernumerary seemed to be a good thing. There was a carious molar and a supernumerary molar just waiting to erupt in its place. He wondered how often one could make use of those supernumeraries to replace other teeth.

Mr. H. L. Leech asked if Mr. Gardiner included cleft-palate cases in the series of supernumerary teeth.

Mr. E. S. Broadway showed three slides and asked for Mr. Gardiner's comments.

The first slide showed a case which had recently been sent to him of a supernumerary in the upper anterior region, in July. The next slide showed the picture in October, the supernumerary having been removed 2 months previously. The third slide showed that it had come back again.

The supernumerary had, in fact, been removed by a very able general practitioner. He had dissected the tooth out most carefully, and had been a little disappointed that the upper central incisor had not, in fact, erupted as he thought it should have done. He had taken a new X-ray in January, 6 months after the original supernumerary was removed, and discovered that, in fact, the thing had recurred.

Professor Poynton had described a case in an American journal where premolars had recurred following the removal of supernumerary premolars.

Had anyone else seen similar cases, and could Mr. Gardiner, or anyone else, offer an explanation of that rather unusual condition?

Mr. J. C. Richie said there were two points he wanted to mention. First of all, with regard to the geminated teeth and the geminated pulp on the lingual aspect of the upper incisor teeth, it had been his experience to grind those down where they interfered with the bite and to treat the exposed dentine, or near exposure, with phenol.

His other point was the fact that he seemed to get a number of patients sent to him these days where an impacted central tooth had been removed either by the general dental surgeon or the oral surgeon and the patient sent to him to resolve the orthodontic problem. He would like to go into print as advising those practitioners against removing single teeth in that way, because he felt that the dental "cyclops" was probably the most difficult type of orthodontic case to treat.

Mr. A. G. Huddart thanked Mr. Gardiner for a very interesting paper.

On the question of cleft palates, Mr. Gardiner had commented that 43 per cent had supernumerary teeth present. His own feelings were that a lot of these cases showed absence of the lateral incisors in the line of the cleft and the presence of a rudimentary, peg-shaped tooth instead, i.e., a supernumerary tooth so called. He would be grateful for Mr. Gardiner's comments on this.

On the question of midline diastemas, he had had one case of a boy with a diastema of about 9–10 mm. associated with two unerupted supernumerary teeth. These were removed and he was simply kept under observation. Over a period of 2½ years the space progressively closed, with no apparent tipping of the teeth; they seemed to move bodily together. The boy now had overlapping upper central incisors which would have to be treated.

Finally, he asked if Mr. Gardiner felt these unerupted supernumerary teeth could possibly cause resorption of the roots of the permanent incisors.

Mr. B. C. Leighton added his congratulations to Mr. Gardiner on the paper. He had gained the impression, when Mr. Gardiner was speaking, that he considered that the position B in the diagram of the tooth germs was perhaps the one from which supernumeraries most commonly arose. Would one not expect, if they arose at that point, that they would develop more commonly on the labial side of the permanent incisors? He would have thought that they would arise from position C more commonly if they developed on the lingual side of the permanent incisors, as they seemed to most often.

With regard to Mr. Broadway's case, he himself had been taught, when removing all unerupted teeth, to curette away the tooth follicle. Was it possible that the dental surgeon who removed them did not curette the tooth follicle and left some of that behind?

Mr. A. J. Walpole Day thanked Mr. Gardiner for his wonderful paper. He had not left much for them to say, but Mr. Broadway, in his observations about the tooth that came back, had reminded him of a similar case of a boy of 14, who had an unerupted central and three tuberculated supernumeraries, one with the whole of the crown formed, one with half a crown formed, and one which was just beginning to form and was just like the thinnest little snowflake of a tooth. A lot of these tuberculated supernumeraries were very late in developing and formed a long time after the permanent teeth.

Mr. W. J. Tulley, referring to Mr. Broadway's comments on a tooth that reappeared, wondered if Mr. Gardiner had seen a supernumerary disappear. Cases had been known of foreign bodies in the floor of the nose showing up and looking very much like supernumerary teeth and, on operation, the endotracheal tube pushed them somewhere.

Mr. E. S. Broadway wanted to ask Mr. Gardiner if he took any precaution to protect patients from irradiation

when taking vertex occlusal films because they seemed to require a very high dosage, and the rays tended to cover the abdomen almost completely when those were taken.

Mr. Gardiner, in reply, thanked Mr. Tulley for opening the discussion so ably.

In reply to Mr. Leech, he said that the cleft-palate patients were extra. An altogether separate survey had been done on those and it was found that the incidence of supernumerary teeth was very much higher.

Mr. Huddart had mentioned pre-deciduous teeth. Could Mr. Huddart tell him the appearance of those? They had been described as shell-like, and Allwright said that the radicular portion had a very small opening, just like the apex of a normal root. Would Mr. Huddart say that they were similar?

Mr. Huddart said that the best way he could describe them was that they were just like a conical incisor lying on the surface of the gum.

Mr. Gardiner asked if they had any enamel formation.

Mr. Huddart said that he could not say.

With regard to Mr. Huddart's question about supernumeraries causing resorption of incisors, the supernumeraries in question just seemed to melt away; they did not seem to have the chance to cause resorption of the incisors.

In reply to Mr. Leighton's question about the position of the developing supernumerary tooth on the dental lamina, if it erupted subsequently to the permanent teeth, he would think that the extent of the root development would possibly show that.

He thanked Mr. Day for presenting so clearly his case of the boy with three supernumeraries in various stages of development.

In reply to Mr. E. S. Broadway, they had now started putting a protective apron over the children when they took the rather long X-ray exposures with a more powerful machine.

CASE HISTORY AND COMMENTS ON ACTINOMYCOSIS

A 41-year-old white man was referred for investigation of a possible dental cause for symptoms which arose some weeks before and which manifested themselves as a painless swelling near the left mandible 5–6 mm. below the sublingual gland. The swelling was freely palpable, but firmly attached to the deeper tissues; there had been no feeling of illness, and no dental cause could be found to account for the lesion. During a stay in hospital of about six weeks, a mainly exploratory operation was performed and a purulent exudation was found in the affected area which was shown bacteriologically to be actinomycotic in origin. Drainage was established, and massive doses of penicillin and sulpha drugs were given. Evidence was now forthcoming that the patient had been a farmer and had chewed straws, some of which had become lodged in his throat.

Comments.—Actinomycosis is not rare; it has not always a rural connexion and a correct diagnosis is important because with the effective treatment available the prognosis is good. The responsible branching micro-organism is about one micron in diameter and Gram positive. The organism is normally present in the mouth, particularly around carious teeth and the gingivæ; it can be found in the tonsils, is anaerobic, and not found in nature.

The cervico-facial area is most commonly affected and it may occur in the chest and abdomen. Involved tissues at first become hard with suppuration, which soon spreads to adjacent structures, forming multiple draining sinuses. Necrosis finally develops and the abscesses discharge "sulphur" granules. Cervical involvement is usually secondary to dental extraction or fracture of the mandible. The mandible is usually affected at the angle with subsequent involvement of the neck and face. The only early symptom of the disease may be a mild fever, and this may be the only symptom even when the lungs and pleura are involved. With the development of fistulæ and abscesses the temperature rises and there may be debility and leucocytosis.

The treatment is drainage, excision, and antibiotics; the drugs are penicillin, tetracycline, chloramphenicol, and sulphadiazine over four weeks.—SUSSMAN, L. M. (1960), *J. Canad. dent. Ass.*, **26**, 608.

G. E. B. MOORE

BOOK REVIEWS

LA MÉTHODE D'IDENTIFICATION PAR LE SCHÉMA DENTAIRE. By HENRI BONNAFOUX. $9\frac{3}{4} \times 6$ in. Pp. 126. 1960. Paris: Librairie Maloine S.A. 9 N.F.

THIS French monograph, on the subject of identification by means of the teeth, is a very useful contribution to forensic science literature. It deals with many aspects of the identification, by means of their dentitions, of human skeletal remains.

Its principal shortcoming lies in the fact that there is no formal bibliography. Of those works that are referred to in the text, only a few have a properly recorded reference to the source of the original articles.

R. W. F.

RADIATION PROTECTION AND DENTISTRY. The Postgraduate Dental Lecture Series. By ARTHUR H. WUEHRMANN, D.M.D. (University of Alabama School of Dentistry, Birmingham, Ala.). $7\frac{5}{8} \times 4\frac{3}{4}$ in. Pp. 238. Illustrated. 1960. St. Louis: The C. V. Mosby Co. (London: Henry Kimpton). 48s. 6d.

THERE have been many papers and books published on radiation hazards and radiation protection during recent years. A high proportion have had a distinctly technical flavour, others have been at the "popular science" level. Relatively few have been at the level of understanding of the non-specialist reader, yet of an academic level appropriate for study by graduate dental surgeons. This little book follows the middle road with considerable skill. Just the right amount of explanation of physical phenomena is given to enable the reader to understand the writer's main theme, even if his knowledge of physics has become rusty. The style is informal, while only occasionally lapsing into a dramatic vein. Even then there is some justification for the author's shock tactics. A considerable amount of information has been collected together and, although intended for the general practitioner, the specialist will find much to interest him. The standard of production is high and there is a good bibliography. On points of detail the book refers to American technique, equipment, and materials, but the main argument is of general application and this work may be strongly recommended to all who practise dental radiography.

G. R. S.

WROUGHT WIRE TECHNIQUE FOR PARTIAL DENTURES. By RUDOLF SCHEU (Previously *Die Klammerkreuz- und Bügeltechnik*, Hagen, 1958). Translated from the German by J. ALLAN WARR, M.A., B.Sc., B.D.S., L.D.S. R.C.S. (Eng.). Ninth and Revised Edition. $8\frac{3}{4} \times 5\frac{1}{2}$ in. Pp. $108+x$, with 193 illustrations. 1960. Bristol: John Wright & Sons Ltd. 22s. 6d.

THIS book is really an instruction manual for those who use the author's prefabricated wire forms for the construction of wrought clasps.

There is more to the book than mere instruction, but unfortunately over-condensation makes it difficult to read and, in parts, very difficult to understand.

The section on the principles of partial denture construction is sound, but contains little that cannot be found elsewhere. Both in this and the subsequent section on clasps forms and their application, the diagrams lack sufficient explanation to make them readily comprehensible and one is left with the feeling that not all of them are correct.

The second, third, and fifth parts of the book are concerned with technique and the application of the clasps described in certain illustrated cases.

The fourth part describes a root cap technique that would not find many supporters in this country.

To users of the author's clasp forms, the book will be of great value, but cannot be enthusiastically recommended to the average practitioner.

A. O. C.

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